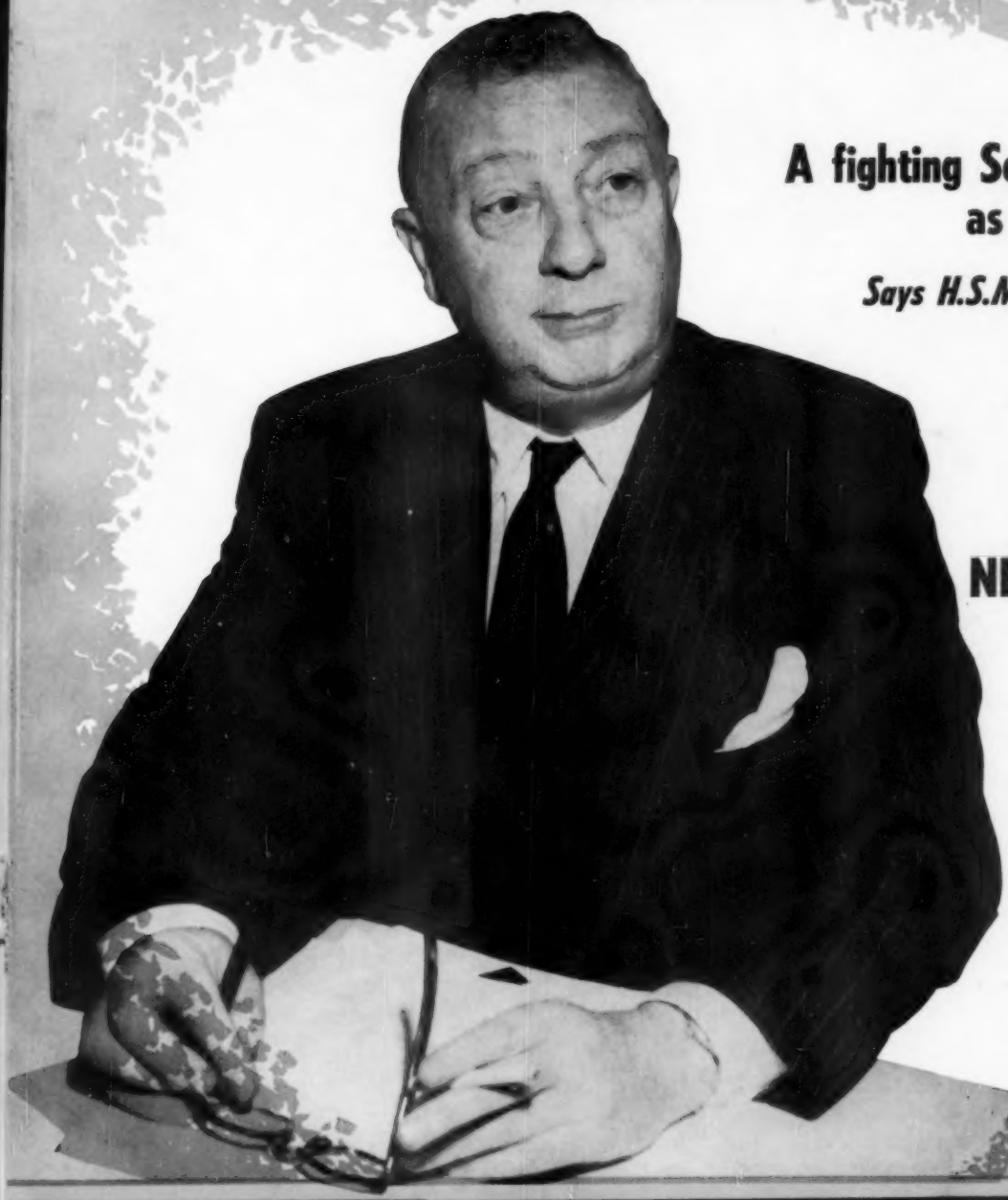
the OIL AND GAS JOURNAL

NOVEMBER 18, 1957

Special API Number



A fighting Scot takes over as API chairman

Says H.S.M. Burns:

"There's an awful lot of pussyfooting in the oil business."

API NEWS REPORT

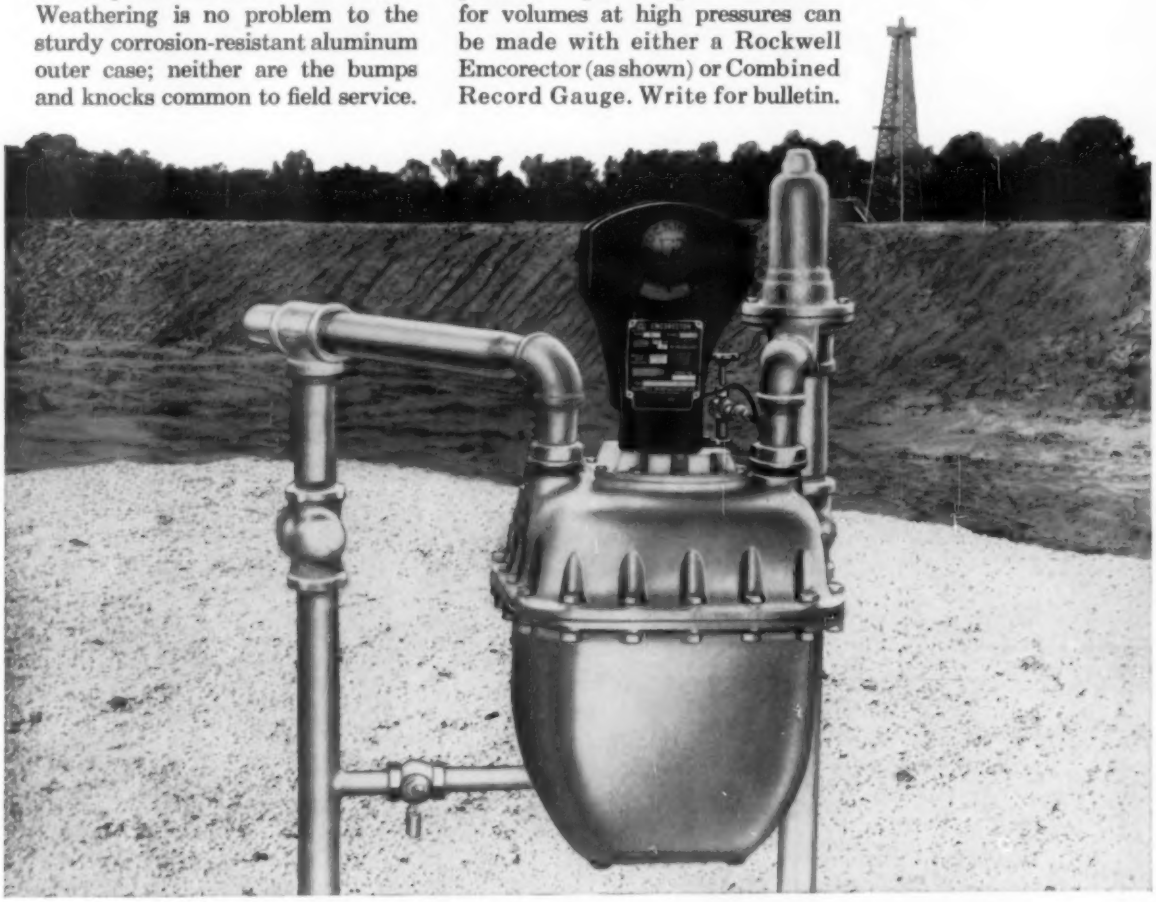
starts page 129

The LIGHT way to measure field gas

(at up to 100 lbs. working pressure)

The Rockwell "1600" is your best bet for measuring gas sold or used around the lease. Here's why. This meter weighs only 63 lb., so is easy to carry onto location and install. Weathering is no problem to the sturdy corrosion-resistant aluminum outer case; neither are the bumps and knocks common to field service.

With it you get a generous capacity rating of 1600 cfh at 4 oz inlet pressure. You can increase this rating materially by measuring gas at higher pressure—up to 100 psi. Corrections for volumes at high pressures can be made with either a Rockwell Emcorector (as shown) or Combined Record Gauge. Write for bulletin.



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The OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
Nov. 18, 1957

Oil men got a preview of 1958 during API sessions:

An imposing array of experts unlimbered predictions, reviewed industry plans, reported on past projects. Tone of their talks: 1958 will be a year for tightening belts, putting on work clothes, taking new approaches.

From the mass of words, this much emerges:

Demand: A 2.6 per cent increase for all products domestically. This breaks down to a 3 per cent increase for gasoline, 2.4 in middle distillates, about the same for residuals, 8 per cent for jet fuels, 4.1 for rest.

General business: Depression of major proportions is out —at least within next few years...Activity will decline in 1958 while economy goes through adjustment...Then our dynamic economy will go higher, hit more profitable levels...Capital spending will be off generally but for oil it'll be up about 1 per cent over 1957.

Steel goods: Production of oil-country steel has hit new peak at same time first big postwar drilling slump came. Result is heavy inventories. Suppliers now feel this inventory burden must be shared by major oil companies, distributors, and the manufacturers.

Politics: Oil is still in the public's doghouse, still the easy target of political demagogs, still faces some grim investigations and restrictive legislation.

Public Affairs: OIC and APIC eventually will be merged into a new public-affairs division with one chief. Washington spokesman idea will be pushed. Top executives will get out more, talk more, testify more before any of the congressional committees.

Research: More work needed on reservoir control and stepping up recoveries...Good results are showing up on refinery studies into static electricity in handling products. Hope is held that new work may develop more precise pattern for hydrocarbon blending.

You'll hear oil companies talking more and more about their manpower reserves in days ahead.

Shortages of technical workers will continue. It'll extend into ranks of skilled craftsmen and talented clerical and sales personnel.

Data given API for general industry also apply to oil. They show by 1965 companies will need 137 professional and technical men for every 100 needed in 1955; 124 skilled craftsmen and 127 clerical and sales persons for each 100.

The manpower payoff will go to companies who have well planned management-development and employe-training programs. (p. 219).

Oil often is criticized as big business.

And the industry does contain some huge enterprises.

But the role of small business within the industry is still important.

Journal editors have taken the industry apart by divisions and show how the little man can carve out a niche for himself in oil. It's a special section beginning on page 255.

Market for petroleum-derived fertilizers and inhibitors will open up when the interstate highway program gets rolling.

Recommended right-of-way for superhighways, except in the urban areas, is 300 ft. wide. That means 1,500,000 acres, only a small fraction of which will be taken up by roadways. The rest is to be landscaped.

Some of the Gulbenkian oil fortune made in the Middle East is returning in the form of philanthropy.

Trustees of the Calouste Gulbenkian Foundation in Lisbon have announced the second list of grants totaling over $2.3 million.

About half will be spent in the Middle East on projects in Iraq for benefit of Armenian communities there and in other parts of the region. Rest is promised to projects in Portugal, United Kingdom, and the British Commonwealth.

France may come up with first nuclear tanker.

Atomic energy and marine experts of France already are working on plans for a 40,000-ton, 40,000-hp. vessel. Several different types of reactors are under study to power the prototype vessel.

API transportation sessions, on other hand, heard U. S. may have a 10-year wait for its first commercially competitive nuclear ship.

Nuclear ship is technically feasible now. But costs must be brought down sharply before it becomes economical. That's expected to take at least 10 years.

You can mark this down as nearly certain: All of the

more fully developed areas in huge Spraberry Trend area field will be water flooded within the next few years.

Sohio Petroleum is moving ahead with its plans. It will unitize and flood up to 100 sections in central part of field. Sohio also got good reaction from other operators in vicinity.

As a result Magnolia is now looking into a unit on its large holdings. Cities Service and Sinclair are doing likewise for their acreage.

The operators have formed operating and engineering committees. These groups will thrash out such things as unit lines and study ideas on how many and large the upcoming projects should be.

Continental Oil is expected to start drilling next year in two widely separated remote areas—Libya and Guatemala.

Preliminary exploration work is now under way in both regions. Conoco holds large concessions in both areas with Ohio Oil and Amerada Petroleum.

The Navy may sue for subsidence damages at Long Beach.

Navy admirals reportedly have asked Justice Department lawyers to explore possibility of suing operators in Wilmington field.

The land sinking there is caused by oil withdrawals and has done multimillion dollar damage to the huge Long Beach naval base.

Naval officials point to a 30-year-old Texas court decision to bolster their case. That oil suit involved land along Goose Creek near Galveston. It subsided below high-tide line. The court ruled the subsidence was caused by oil withdrawals.

Targets for the suit have not been picked. Navy officials hold that the state, city of Long Beach, and private oil men are parties involved. The Navy earlier warned that unless remedial work starts by next April, the $170-million base may be closed.

Silicone aluminum paint provides the means for detecting hot spots in catalytic cracking vessels on the Gulf Coast.

The paint contains Dow Corning's 805 heat-stable resin.

When heat spots develop on the shell of a vessel, silicone paint takes on an exceptionally high glaze in the immediate vicinity. Light reflected from this area acts as a telltale beacon to the operator.

Usual remedial steps: A steam spray temporarily to cool the hot spot until permanent repairs can be made during downtime.

Short cuts for measuring road octanes of today's gasoline are attracting interest among refiners.

The result is better data every year to guide refiners.

It appears now that 100-plus-octane fuels can be road rated satisfactorily by laboratory means, using research and

motor numbers modificed by olefin and aromatic content.

Actual road-octane measurements by cars still will be necessary. But the short-cut computations are reducing need for much expensive work.

Another gas-price collision between FPC and producers looms.

Transco's 1958 program may bring it to a head. Transco has contracted for large reserves on the Texas and Louisiana Gulf Coast for 21.5 to 22 cents per M.c.f.

FPC has objected to even a 20-cent price, leans toward 18.

A repetition of last summer's CATC showdown is possible. CATC then bucked FPC's 4-cent price cut and made its 21.4-cent price stick.

New policies on Canadian gas are in the making.

In Washington, FPC may have to set up a new line of thinking on gas imports in light of a possible freeze on export permits by Canadians.

In Ottawa stiffer governmental controls on exports may emerge from study now being made by Borden royal commission. This group eventually may come up with plan for a central Canadian agency to regulate gas business somewhat along lines of our own FPC.

Some fear a ban on exports, but Alberta's Premier Manning is convinced Prime Minister Diefenbaker won't hold up gas exports until the Borden commission reports. He thinks decision on permits will come quickly.

Result for American interests is this: It may be impossible for any company to finance a new pipeline project involving gas from Canada until the air has cleared.

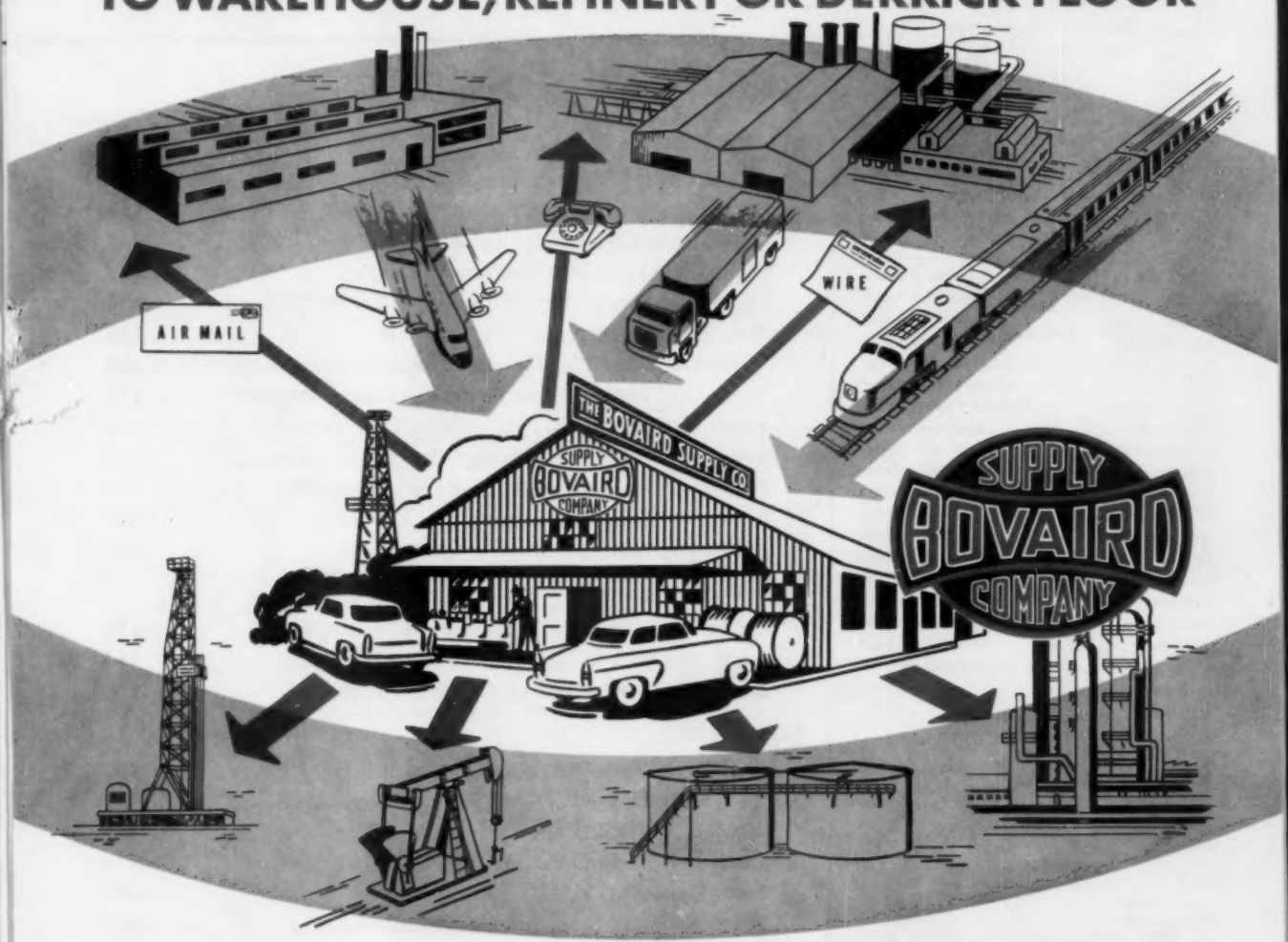
Egypt seems to be doing a good job of running the Suez Canal.

Survey made by the American Merchant Marine Institute indicates operations are going on in usual manner. There are no unusual delays. Egyptians are courteous and efficient.

Exploration notes: Venezuela has two important discoveries. Colon Development's wildcat near Colombian border tested at rate of 2,000 bbl. daily. Four-company group headed by Signal has a 2,400-bbl. daily producer in Block 4 in Lake Maracaibo...Stepped-up Cuban play is highlighted by La Estrella's 1 Manuay a mile off the northern coast of Camaguay. It is currently drilling below 1,800 ft. and is scheduled for 12,000-15,000 ft...Pan American has backed up the hole to test other zones in its 1-CS University in Pecos County, Texas. A 1,600-ft. fish halted drilling on world's second deepest well. ...Texas Eastern, the big pipeline outfit, may jump into oil exploration abroad. Its agents have been in Paris scouting possibilities of getting a concession in Sahara region of North Africa.

From Factory or Store....

TO WAREHOUSE, REFINERY OR DERRICK FLOOR



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SPECIAL API SECTION

How the API Is Helping To Answer Geological Problems 159
By C. I. Alexander
The Geological Research Program of the API is devoted to answering these questions: (1) What are the source materials of petroleum; (2) how are they converted to gas and oil; (3) what is necessary for their operation; (4) how important a factor is time.

API Research Provides Many Answers 163
By H. W. Field and C. E. Headington
These projects cover many fields including the identification of pure hydrocarbons, knocking characteristics of hydrocarbons, thermodynamics properties of compounds, high-molecular-weight hydrocarbons, and sulfur and nitrogen compounds in petroleum.

Static Electricity In Petroleum Products 166
By D. T. Rogers, J. P. McDermott, and J. C. Munday
The production of static electricity in liquid hydrocarbon fuels is associated with the presence of colloidal contaminants which ionize in the hydrocarbon environment. These contaminants are largely organic in nature and come from treating operations.

Reducing Static Elctricity By Radioactive Material 197
By J. J. Conradi, J. R. Miller, and J. J. Skelly
When put inside a storage tank, a radioactive source functions to reduce static electricity by ionizing the vapor space and thereby producing a conductive path through which the charge on the hydrocarbon surface can be dissipated. Here is a progress report on laboratory and fullscale experiments.

Generation and Prevention of Static Electricity 204
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Geologists now have an effective method for determining the time since certain geological processes occurred. This depends on the radioactive decay of certain naturally occurring isotopes.

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Oil and Small Business 255
Though oil is big business of necessity, there is a place in the industry for small business. There are thousands of small oil businesses and they are represented in every branch of the industry. In some branches, the small business predominates.

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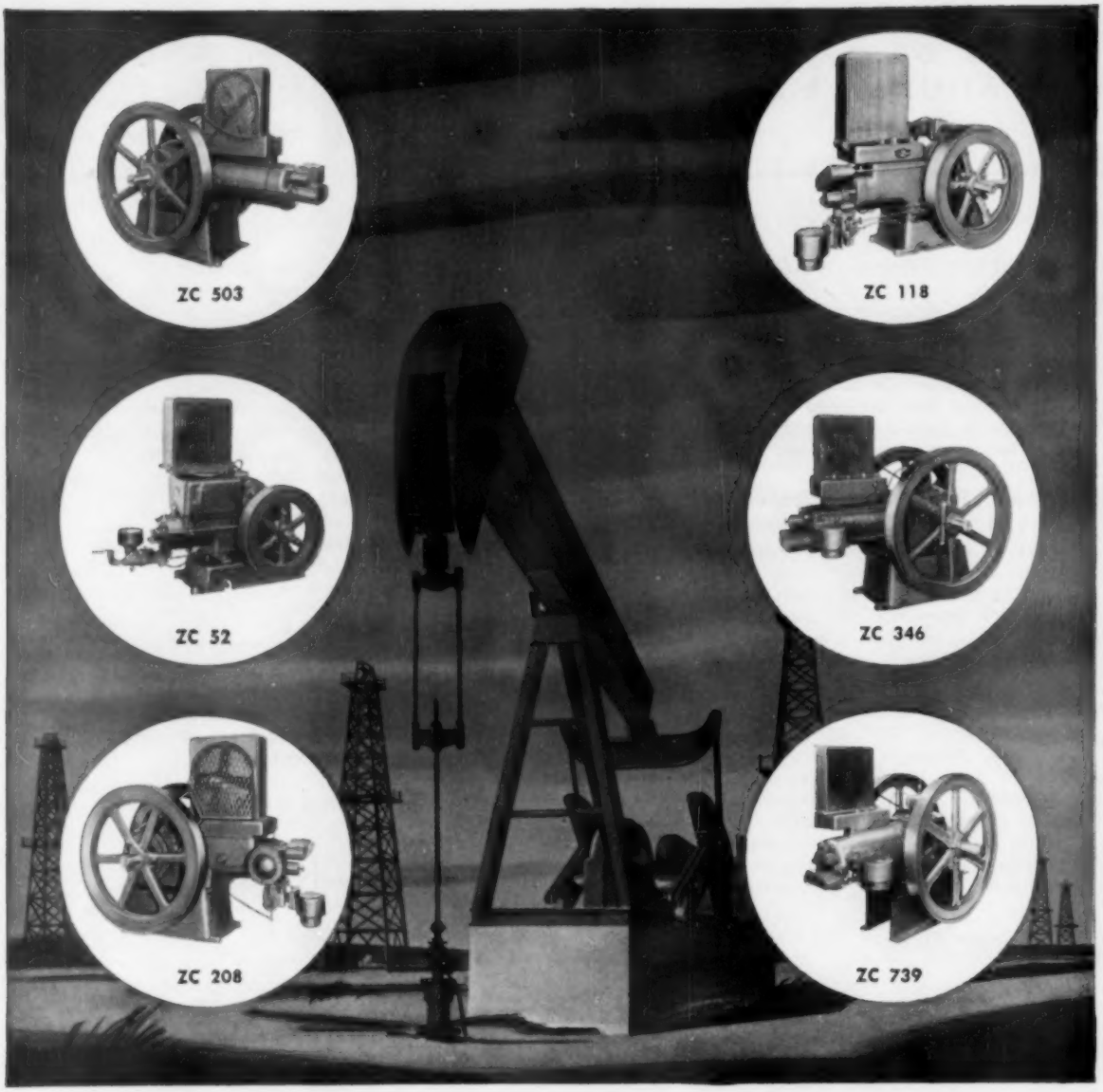

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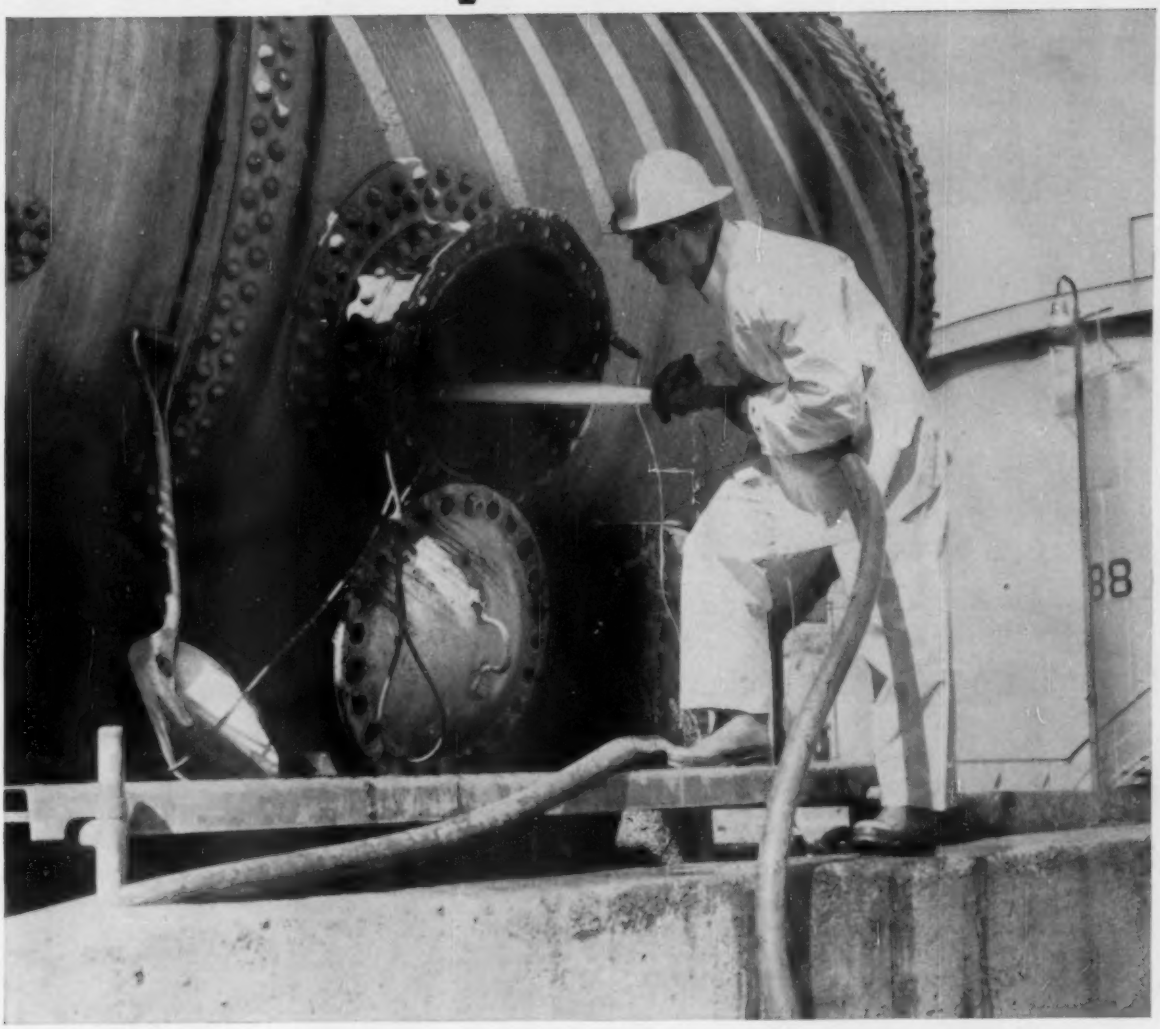

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1½	2,800 psi	5,650 psi
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2	1,600 psi	3,180 psi
2¼	1,250 psi	2,520 psi

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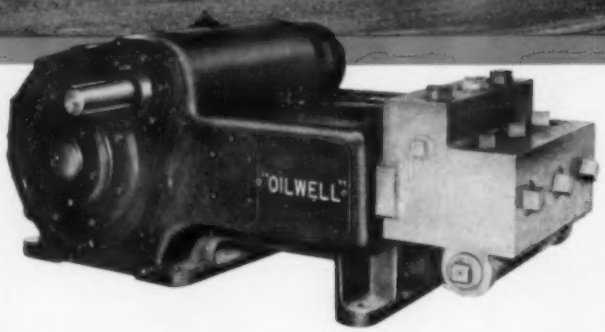

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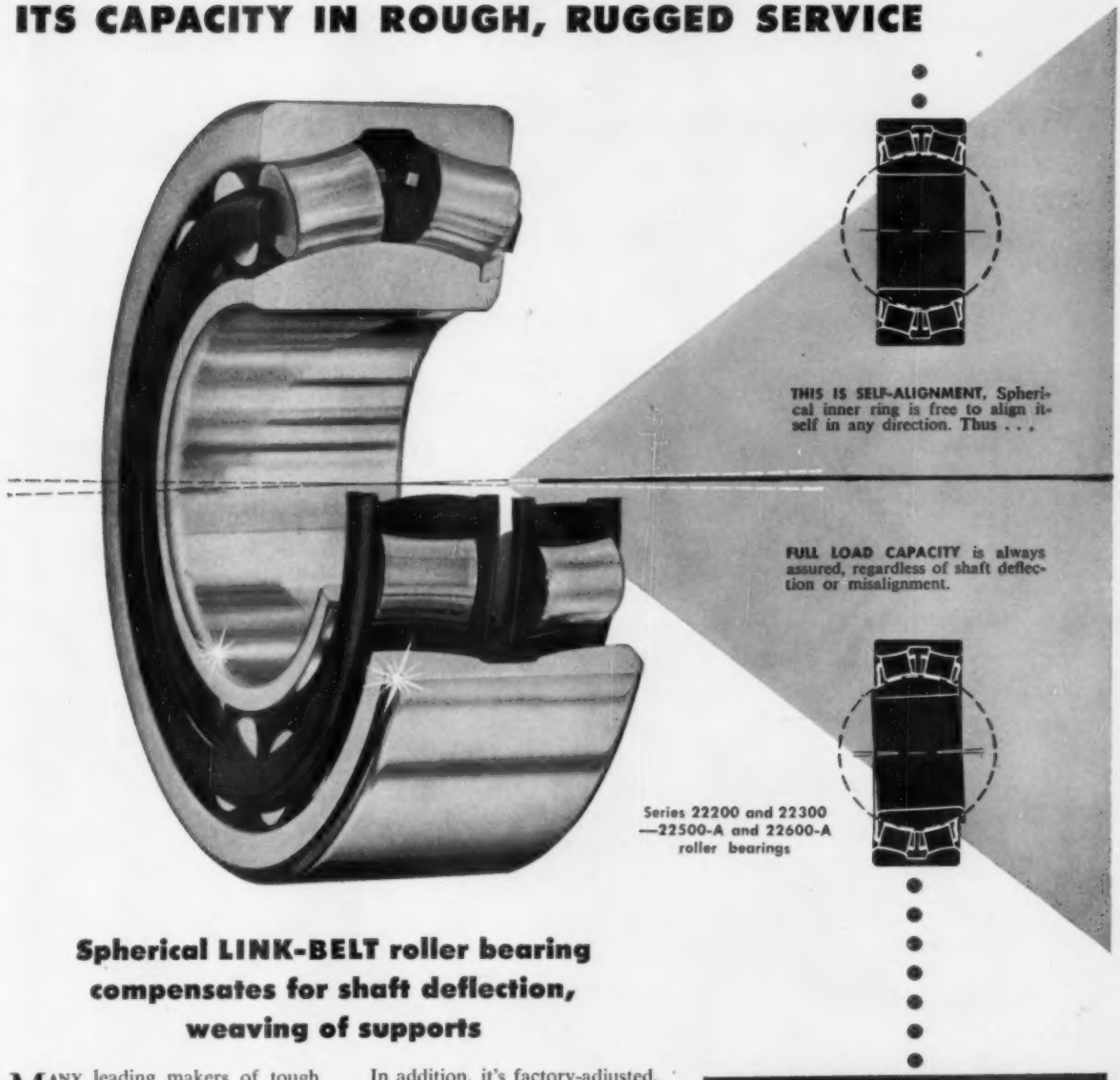
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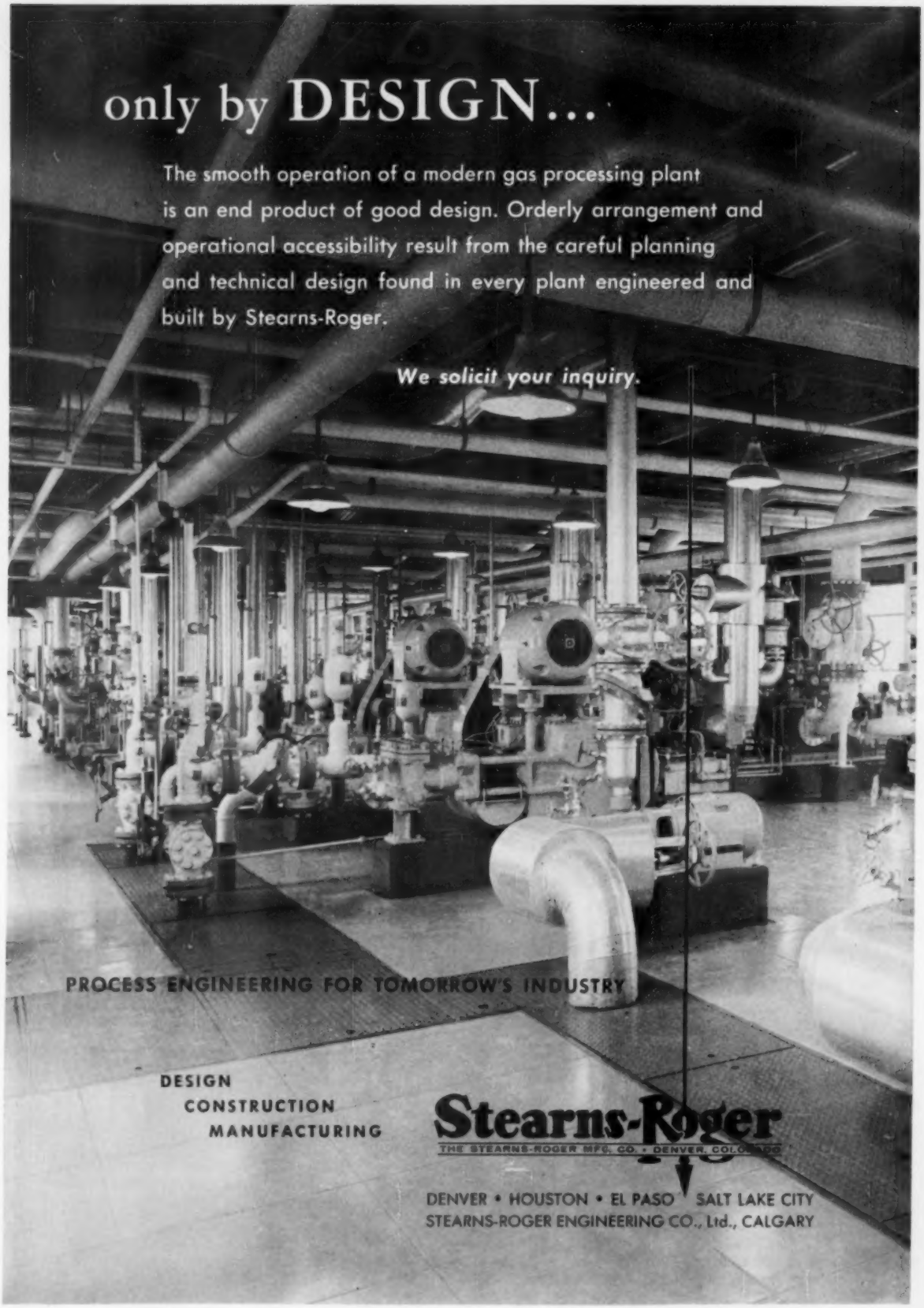
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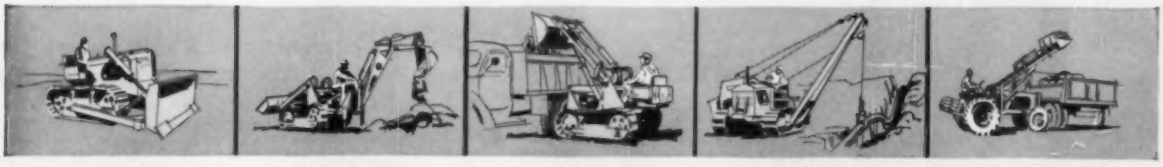

BULLDOZERS BACK HOES LOADERS BOOMERS WHEEL TRACTORS

At the Rock of Ages granite quarry in Barre, Vermont, a derrick with a bucket platform is used to lower crews to the bottom of the 360-foot quarry. With the lives of scores of men at stake they know that they can...

...lower away in safety

You may not operate derricks carrying ten-man loads or 50-ton blocks of granite, *but safety should be just as important to you.* A "bargain" rope may save you money —but if it fails it may cost more than you bargained for. Buy rope on the basis of quality—buy Wickwire Rope.

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WICKWIRE ROPE — A CF&I PRODUCT

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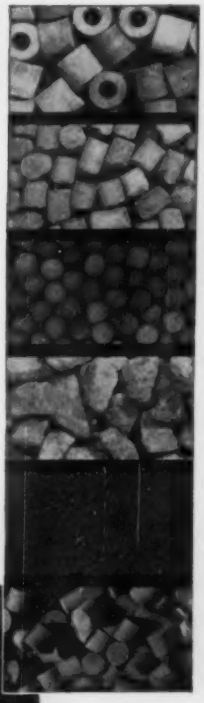
HYDROGENATION CATALYSTS

How Girdler helps you solve hydrogenation problems



• There are three important cost-cutting ingredients in Girdler catalyst service for hydrogenation applications:

1. Girdler's *proven hydrogenation catalysts,* such as listed, which are providing optimum operating economy in a wide variety of uses.

2. Girdler's accumulated *technical know-how* which is constantly finding new solutions to difficult hydrogenation problems.

3. Girdler's extensive catalyst *facilities* . . . manufacturing, research, development and technical service . . . which provide the ideal catalyst for *your* application.

Outline your catalyst problem and we will make specific recommendations. Bulletin GC 1256 describes the full line of Girdler catalysts . . . available on request.

NICKEL CATALYSTS	Leaders in the generation and purification of synthesis gases, and for a wide variety of organic hydrogenations. Girdler's close control of reduction and careful selection of support materials impart unique properties for difficult process problems.
COPPER CHROMITE CATALYSTS	One of most highly active and versatile commercial hydrogenation catalysts. Available in regular and barium-stabilized types either as powder or especially strong pellets. Powder meets certain specific particle density requirements.
SELECTIVE HYDROGENATION CATALYSTS	Widely used to selectively hydrogenate acetylenic and diolefinic compounds in purification of olefins. Custom made to give optimum performance with due regard for process variables and contaminants. Facilitate production of high purity olefins for petrochemical processes.
COBALT MOLYBDENUM CATALYSTS	Used extensively by many refineries. Highly active. Developed specifically for sulfur conversion and for hydrogen treating to remove sulfur and nitrogen . . . also for upgrading a wide range of petroleum feed stocks. Excellent physical properties assure high operating economy and long life.
NOBLE METAL CATALYSTS	Pelletized forms of platinum and palladium catalysts for special applications. Advanced techniques produce highly active catalysts, economical both in manufacture and use.

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the **GIRDLER** Company

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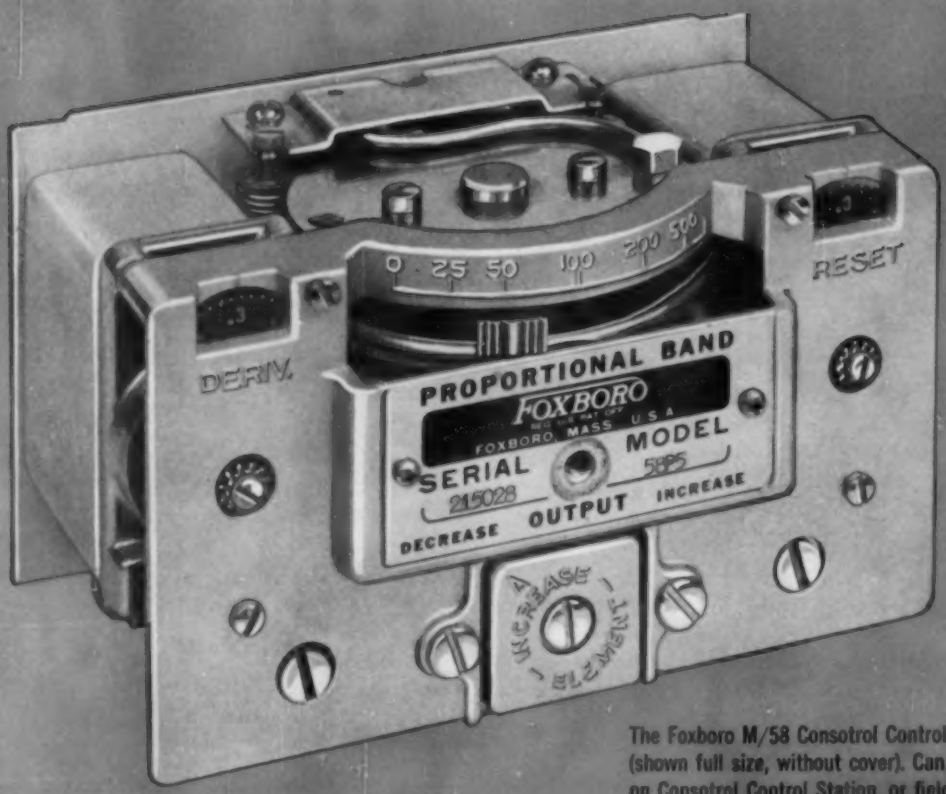


The Foxboro M/58 Consotrol Controller (shown full size, without cover). Can be panel-mounted on Consotrol Control Station, or field-mounted.

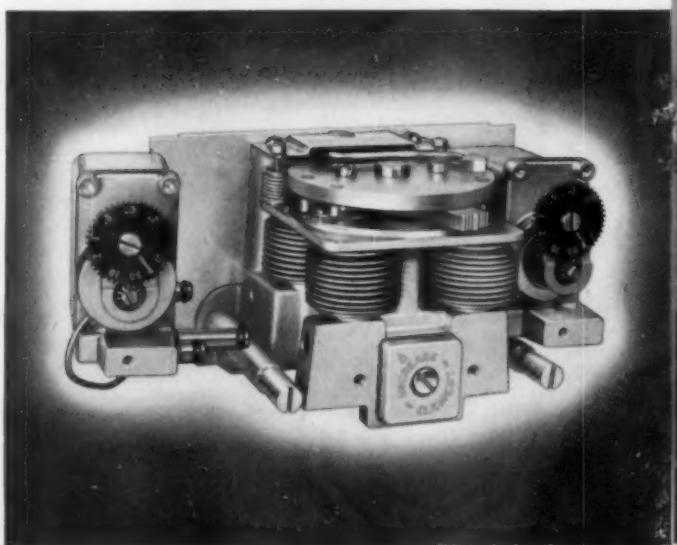
THE FOXBORO M/58 CONSOTROL

The M/58 Controller's Revolutionary Floating Disc System

Here's the exclusive Foxboro design development that gives M/58 Control its unique versatility, precision, and stability. The floating disc and matched bellows assure uniformly high controller sensitivity and pin-point control action, even at widest settings of the proportional band. Lever-set proportional band adjustment is calibrated to 500%.

Component Construction Gives Unrivaled Versatility

Not only is the complete controller easily detachable as a unit, but also, each component is a "plug-in" unit. For example, reset plugs in at right as shown; derivative, similarly, at left. All 4 control actions, with 2 reset ranges, are available and easily adjustable to widest variations in operating conditions. Proportional action from 1 to 500% quickly set by lever.



Outperforms all other controllers!

...the controller with the FLOATING DISC

If you think this claim is exaggerated, just put a Foxboro M/58 Consotrol* Controller on your process. The tougher the job, the more it will outperform other controllers! Or ask any present user . . . many of the largest, most progressive petroleum and chemical processors are using hundreds of these instruments. They will unhesitatingly confirm that this exclusive Foxboro development has put their processes "on stream", automatically and smoothly from the control room, without false starts or confusion.

The M/58 Controller can do the same for your process. The flexibility of its control functions makes it readily adaptable to *all* processing techinques. All four actions are available, with two ranges of reset . . . all are easily adjustable to the most widely varying operating conditions. For example, reset and derivative functions plug in . . . proportional action from 1 to 500% can be quickly set by a lever. And calibration is a simple zero adjustment!

Get full details on this simple, truly "universal" Controller. Write for Bulletin 13-19 and ask your Foxboro Field Engineer for a demonstration. **The Foxboro Company, 6011 Norfolk Street, Foxboro, Mass., U.S.A.**

*Reg. U.S. Pat. Off.

FOXBORO **CONSOTROL INSTRUMENTS**

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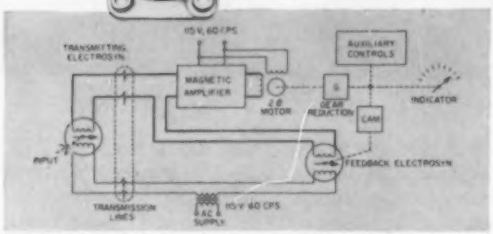
ELECTROSYN AT WORK

Leading pipe line companies are putting ElectroSyn Systems to work measuring and indicating operation pressures and flows and for digital telemetering.

Featuring high reliability, low maintenance and flexibility of application, the ElectroSyn System can withstand a static overload of 300% of rated pressure for a 1% zero shift.

Model 501



Basic Null-Balance System for Pressure, Differential Pressure, Level

Basic system consists of signal transmitter, magnetic servo amplifier, null-balance indicator. (No electron tubes, slide wires or continuously moving parts.)

In measuring pressure the Model 501 transmitter utilizes a twisted bourdon tube as the pressure sensing element. This tube converts the pressure into shaft rotation of the ElectroSyn signal generator, a rotary differential transformer. Output from the ElectroSyn signal generator is an a-c voltage exactly proportional to the measured variable.

Write for Brochure B257

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TEXAS EASTERN TRANSMISSION CORP.
•
GULF INTERSTATE GAS CO.
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SOUTHERN PACIFIC PIPE LINES, INC.
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NC NORWOOD CONTROLS

NORWOOD CONTROLS UNIT

DETROIT CONTROLS

Division of AMERICAN-Standard

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Sand-Water fracturing uses fresh water, salt water or oil field brines as the fracturing and sand-carrying fluid. In many areas Sand-Water is the most effective, economical treatment for production improvement.

Particularly adaptable to water wells and gas wells, it is also effective in many oil wells.

You save because water is the most economical universally available fluid. Safer, easily handled, Sand-Water can be modified with Halliburton's WLC-1 for fluid loss control and wide selection of chemicals to meet varied well conditions.

In addition to fracturing, permeability can be increased by the dissolving of water soluble components present in the formation.

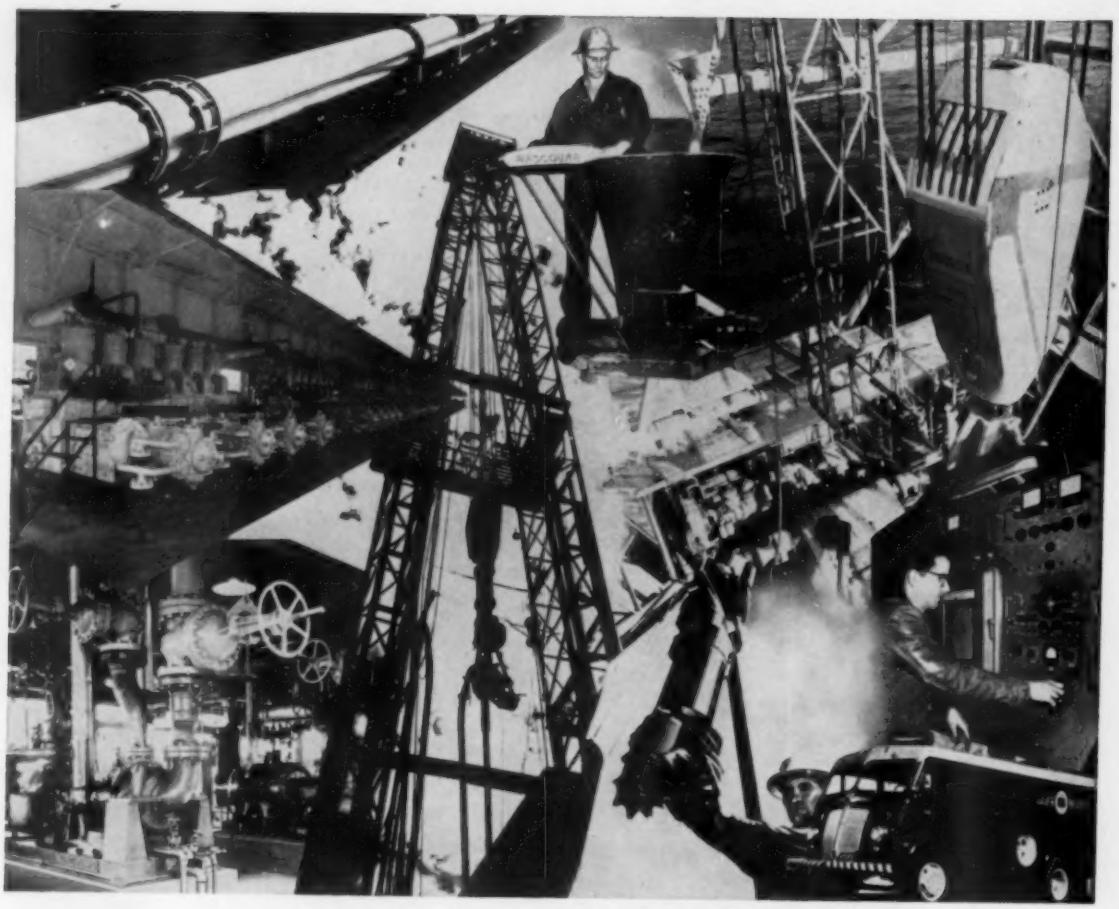
Large volume, high injection rate treatments normally give better results... less expensive with Sand-Water.

Money-saving suggestion:
See your Halliburton service representative.

HALLIBURTON OIL WELL CEMENTING COMPANY
DUNCAN, OKLAHOMA

PIONEERS IN FRACTURING SERVICES

251 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY RIG



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DRESSER MANUFACTURING DIVISION, Bradford, Pa.—Pipe line couplings, pipe repair sleeves and clamps, weldments, forgings, welding fittings, flanges, rings.

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THE GUIBERSON CORPORATION, Dallas, Tex.—Swabs, packers, anchors, workover equipment—drilling heads, blowout preventers, tubing blocks, hooks, swivels, kellys, savers, unions. Gas lift equipment. Molded rubber products.

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IDECO, Dallas, Tex.—Hydrair* and Power Rigs; Full-View* Masts-substructures; single, dual and Drive-In Rambler Rigs; blocks, swivels, rotaries; mud pumps; petroleum equipment and supplies.

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LANE-WELLS CO., Los Angeles, Calif., Houston, Tex., Oklahoma City, Okla.—Electric and Radioactivity Well Logging, Koneshot* perforating and bullet perforating, packers and bridging plugs.

Magcobar.

MAGNET COVE BARIUM CORP., Houston, Tex.—Magcobar* and Magcogel* drilling muds and other specialized oil well drilling fluids and chemicals.

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PACIFIC PUMPS, INC., Huntington Park, Calif.—Centrifugal pumps for refineries, power stations, pipelines, and chemical plants; plunger pumps for oilwells

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ROOTS-CONNERSVILLE BLOWER DIVISION, Connersville, Ind.—Rotary positive blowers, gas pumps, centrifugal blowers, exhausters, vacuum pumps, and positive displacement meters.

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SECURITY ENGINEERING DIVISION, Dallas, Tex., Whittier, Calif.—Rock bits, reamer rock bits and hole openers; reamers, casing scrapers and Neo-Red rubber stabilizers.

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WELL SURVEYS, INC., Tulsa, Okla. —Nuclear and electronic research and development for the petroleum and other industries. Originators of radioactivity logging.

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You receive a bonus of extra value whenever you are served by any one of the Dresser companies. *Men with imagination* provide the research, engineering, manufacturing and service applications for the particular specialties of each Dresser operating unit. All Dresser companies work together with their combined experience and facilities to form the world-wide Dresser industrial team. This inter-company teamwork offers a bonus in greater experience and technical knowledge—backed by the extensive Dresser facilities—in the customer's specific industry. This intangible but important factor is known the world over as the Dresser plus+... the mark of superior equipment and services for the oil, gas, chemical, electronic, and general industry.

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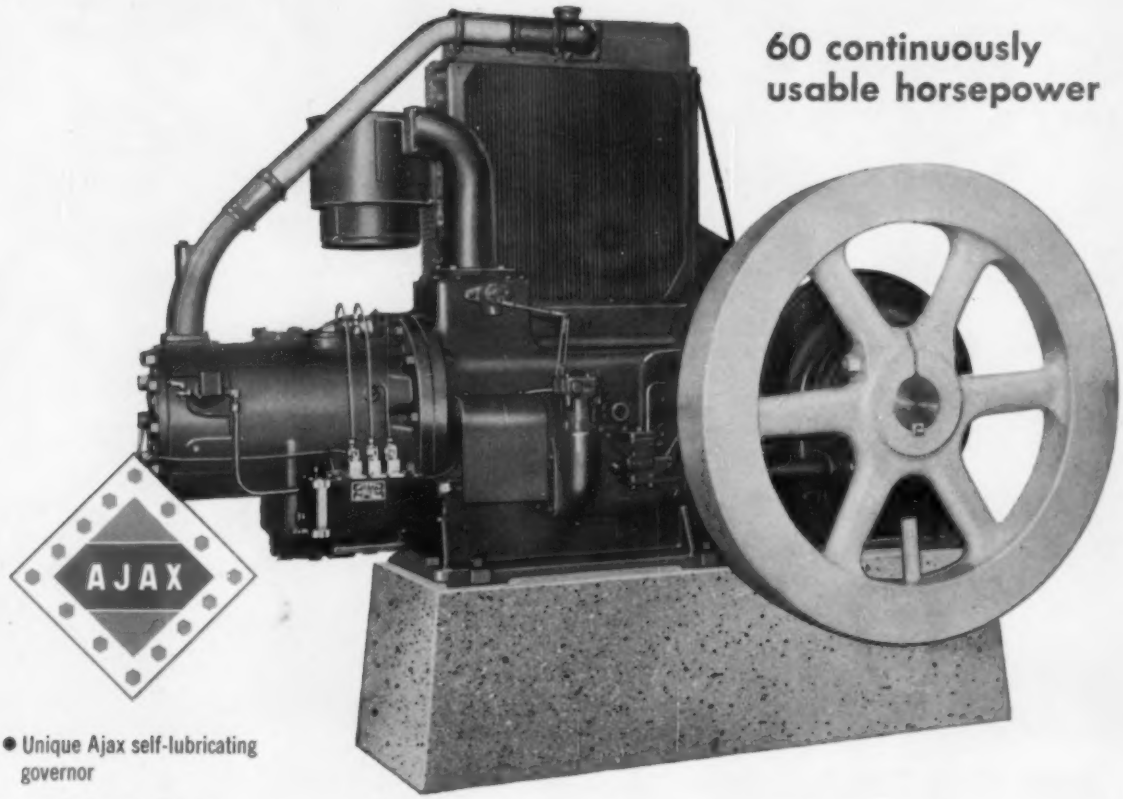
ADDITION TO THE MOST COMPLETE GAS ENGINE LINE!

AJAX DP-60 9½ x 12



60 continuously usable horsepower

- Unique Ajax self-lubricating governor
- New improved cylinder lubrication
- Gasoline, electric or air automatic starting
- Improved extra-long-life fan drive
- Extra-large clutch—extra-heavy crankshaft

This brand-new Ajax fills the horsepower gap between the Ajax 8½ x 10 and the Ajax 11 x 14 engines—providing the oil industry with the broadest range of engine capacities for the greatest number of applications in the field, plus AJAX quality throughout! The 60 hp DP-60 features a completely new Ajax governor—self-lubricating, with continuous oil circulation . . . a new improved cylinder lubricator with ever-clear sight feed, permitting precise proportioning of cylinder lubrication . . . automatic starting, equipped for Ajax-developed gasoline, electric or air starting units . . . improved cooling, with extra-long-life fan drive . . . and an extra-large, conservatively rated clutch. ● For complete details, check with your Supply Man now!

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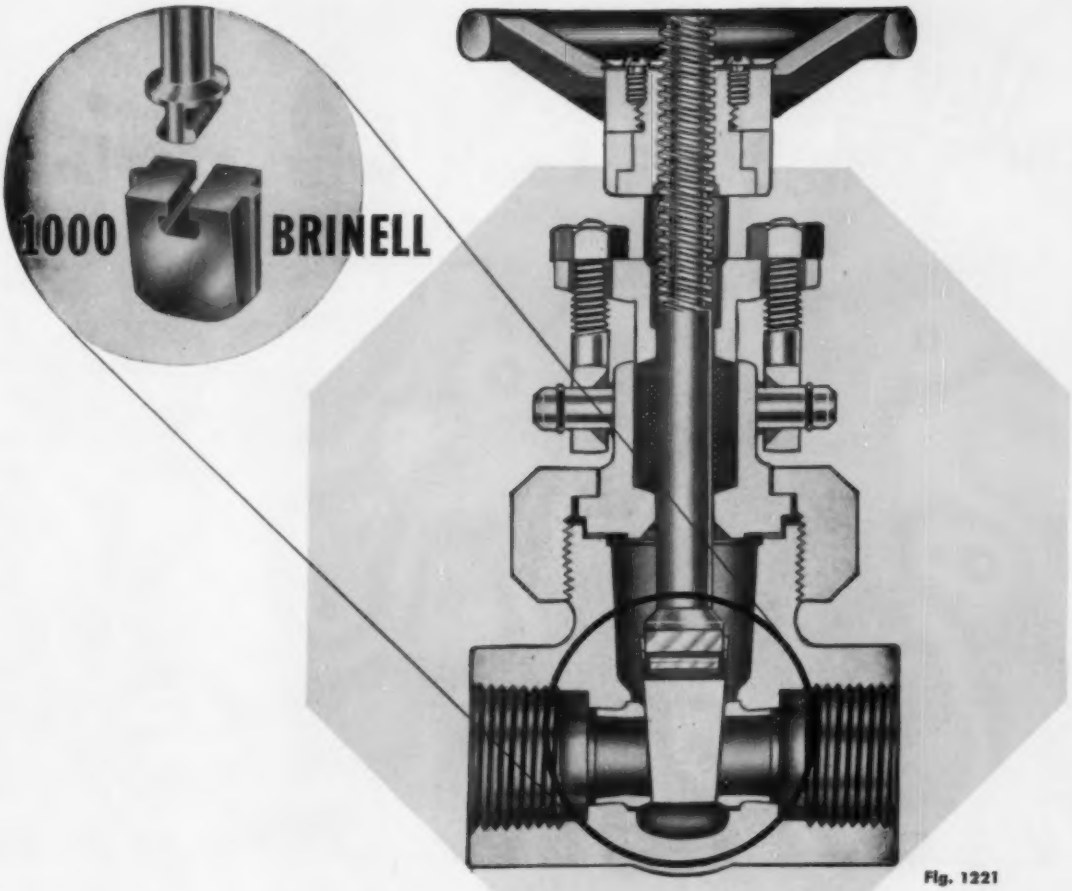

Fig. 1221

Stop Galling with the hardest valve wedges you can buy

OIC VALVES

FORGED & CAST STEEL,
BRONZE & IRON,
LUBRICATED PLUG VALVES

Highly resistant to erosion and corrosion

Here's a wedge as hard as flint . . . so hard that it's undamaged by pipe cuttings, scale or grit. It's the only trim we know of which will successfully withstand the simultaneous attack of the three valve-destroying agents—corrosion, erosion, galling. This wedge is *13% chrome stainless steel hardened up to 1000 Brinell.*

Specify the OIC 1221 gate or 1621 globe where you need the extra rugged nature of forged steel. They are recommended for steam service up to 800°F...oil service up to 1000°F. Or, use these same valves for hydraulic service up to 2000 lbs.

Write for Form 195 for specifications on the OIC forged steel line.

THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO

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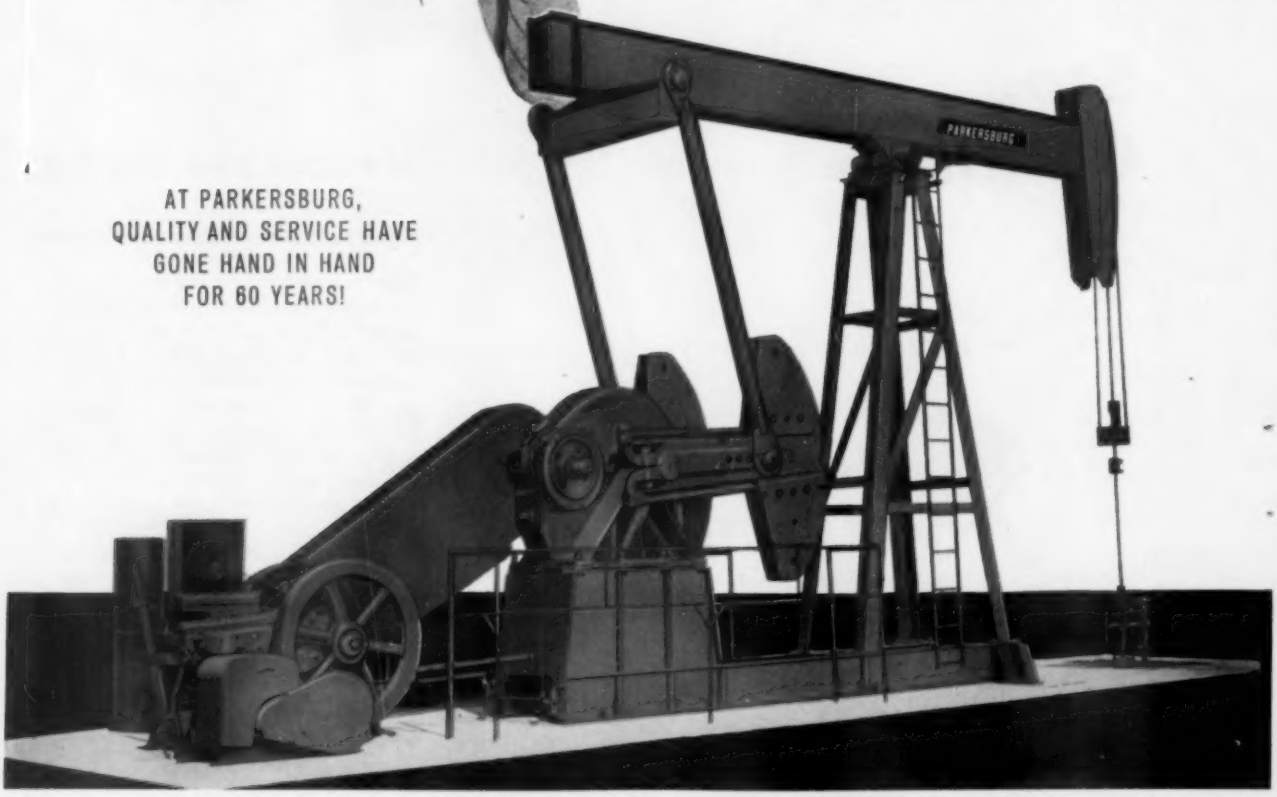
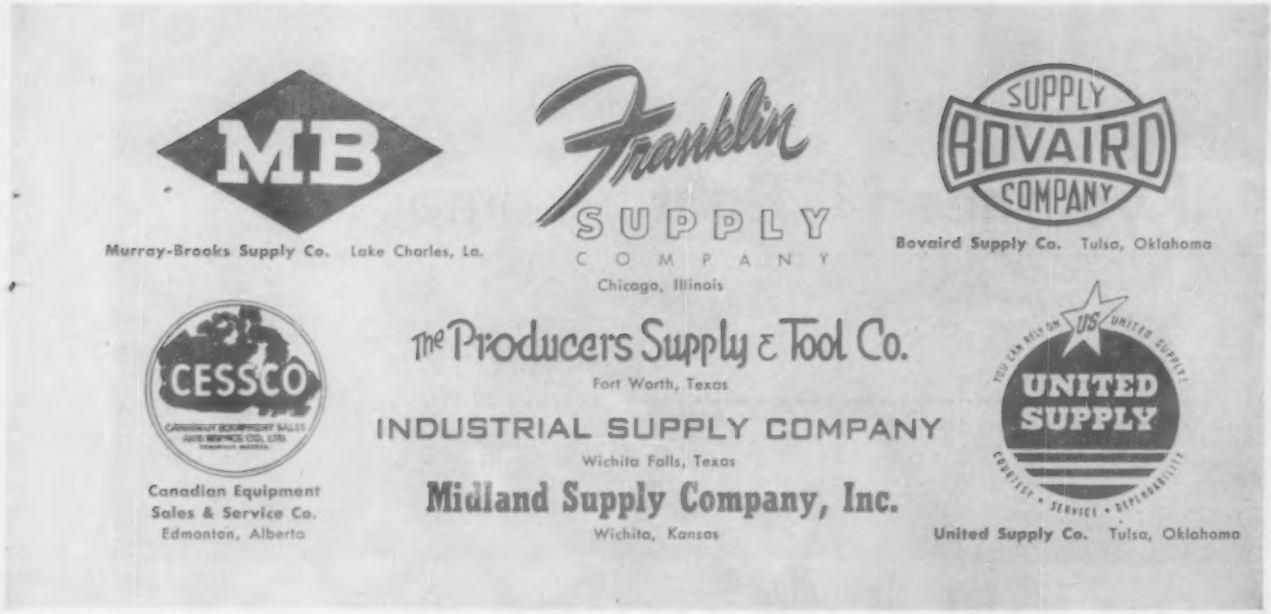
HOMCO
HOUSTON OIL FIELD MATERIAL COMPANY, Inc.
Houston Oilfield Material Co. Houston, Texas

MOUNTAIN IRON AND SUPPLY COMPANY
Mountain Iron & Supply Co. Wichita, Kansas

AT PARKERSBURG,
QUALITY AND SERVICE HAVE
GONE HAND IN HAND
FOR 60 YEARS!



PARKERSBURG pumping units!



Now You Can Buy Famous PARKERSBURG *Pumping Units Under These Familiar Oil Field Signs*

The Parkersburg Rig and Reel Company is proud to announce that 10 leading supply companies with over 100 stores in 19 states and provinces now offer Parkersburg's famous gear-driven and chain-driven pumping units. These stores augment the 20 convenient warehouses maintained by Parkersburg and assure you that, regardless of where your location might be, there are Parkersburg pumping units available in the area.

This means better pumping unit value for you, plus the convenience of one-stop service now available through your supply store. Each unit is backed with Parkersburg's guarantee and liberal service policy.

Gear-driven units are available through these supply stores in size ranges from 25,000 to 912,000 pounds peak torque rating. Chain-driven units are furnished with peak torque ratings from 25,000 to 228,000 pounds.

PUMPING UNIT DIVISION OFFICES: *710 Mid-Continent Building, Tulsa, Oklahoma*

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By Max Ready—Dale Ledbetter
Johnston Testers

FOR MORE INFORMATION ON YOUR DRILL STEM TEST

A check-off list for reverse circulating drill stem tests

PART II

REVERSE CIRCULATION ON GULF COAST (CASING TEST)

Deep tests and high pressures found in the Gulf Coast (Louisiana and Texas) call for more precise reverse circulating procedures on casing tests. Surface pressures above 7500 psi have been encountered and wells below 15,000 ft. have been successfully tested and the recovered fluid reversed out.

While cased holes supply ideal reversing conditions by covering possible sloughing formations and allowing application of pressure in the annulus to speed the reversing process, the high formation pressures must be carefully guarded to prevent blow-outs. Both flow and reversing from these high pressure formations are controlled by 10,000 to 15,000 psi test flow heads.

The Type A Reversing Sub, Type B Reversing Sub and Shut-In Reversing Valves may be used equally well on casing tests. The shut-in reversing valve can be operated to take formation shut-in pressure and provide ports for reversing. These operations can be done separately or simultaneously—at the discretion of the oil company representative.

The practice of reversing from "bottom" and the "simultaneous" operation of the SIR valve is widely used.

Reversing sub or valve locations are dependent on the amount of "sample" to be left in the pipe. The "sample" attains even greater importance in cased holes because a small amount of salt water may indicate a cement "channel" job, which, if unnoticed, might lead to a work-over at a later date.

The SIR Valve can be operated without bleeding down the tubing or drill pipe pressure—an added feature which helps prevent tubing or drill pipe collapse.

If packer remains seated during reversing, pressure applied to the casing annulus will be blocked from the perforations tested.

The speed of reversing can be controlled by regulating the valves on the surface flow manifold and the pressure applied to the mud in the annulus below the closed rams or "Hydril."

By closely checking the weight (pounds per gallon or pounds per cubic foot) of the fluid being reversed out, a minimum of expensive drilling mud will be wasted. Normally reversing will be complete when clean mud of normal pit weight appears at the surface.

Reverse circulation check off list

Before operating reversing valve
- ☐ Pump running
- ☐ Mud line valves positioned to divert mud flow to annulus
- ☐ Rams and/or Hydril checked for operation

Operating Reversing Valve (Type A and/or Type B)
- ☐ Close well in at surface
- ☐ Disconnect high pressure steel flow hose
- ☐ Close shut-in tool by rotating
- ☐ Reconnect high pressure steel flow hose
- ☐ Bleed down drill pipe (if go-devil hanger not used)
- ☐ Check mud in annulus (*must stay full* throughout reversing operation). Packer may be pulled loose if shut-in period is completed.
- ☐ Drop proper go-devil to operate reversing sub
- ☐ Close surface valve (keep closed as long as annulus is *not* full)
- ☐ Control flow of recovery with surface valves so that hole remains full of mud.

Operating Shut-In Reversing Valve
- ☐ Close well in at surface
- ☐ Disconnect high pressure steel flow hose
- ☐ Check mud in annulus (must stay full during shut-in and reversing procedure)
- ☐ Rotate to close SIR Valve for shut-in (if valve is "blanked-off" reversing may be started by further rotation, 11 rounds only—if valve is not "blanked-off," do not rotate into reversing position)
- ☐ Rotate SIR Valve into reversing position (total of 11 rounds)
- ☐ Reconnect steel flow hose
- ☐ Keep surface valve closed as long as annulus is not full of mud
- ☐ Control flow of recovery with surface valves so that hole remains full of mud

NOTE: If reversing stops, apply moderate pressure to annulus or apply moderate pressure to tubing or drill pipe until normal circulation is barely established then go back to reverse circulation.

When natural reversing is completed or to speed reversing procedure
- ☐ Close rams or Hydril
- ☐ Apply moderate pump pressure to annulus
- ☐ Stop pumps when clean mud of normal weight is reversed
- ☐ Remove flow head and come out of hole at proper speed (prevent swabbing). Pipe should pull dry.

This is the second article on Reverse Circulating drill stem tests. The first article covered reverse circulation in the Permian Basin.

For complete information on Reverse Circulation write Johnston Testers, Houston, Texas.

DALE LEDBETTER
Dist. Mgr.
Houston, Texas

MAX READY
Area Mgr.
Louisiana Gulf Coast

Type B Reverse Circulating Sub

Type A Reverse Circulating Sub

Shut-in Reversing Valve

JOHNSTON TESTERS

A Subsidiary of Schlumberger Well Surveying Corporation

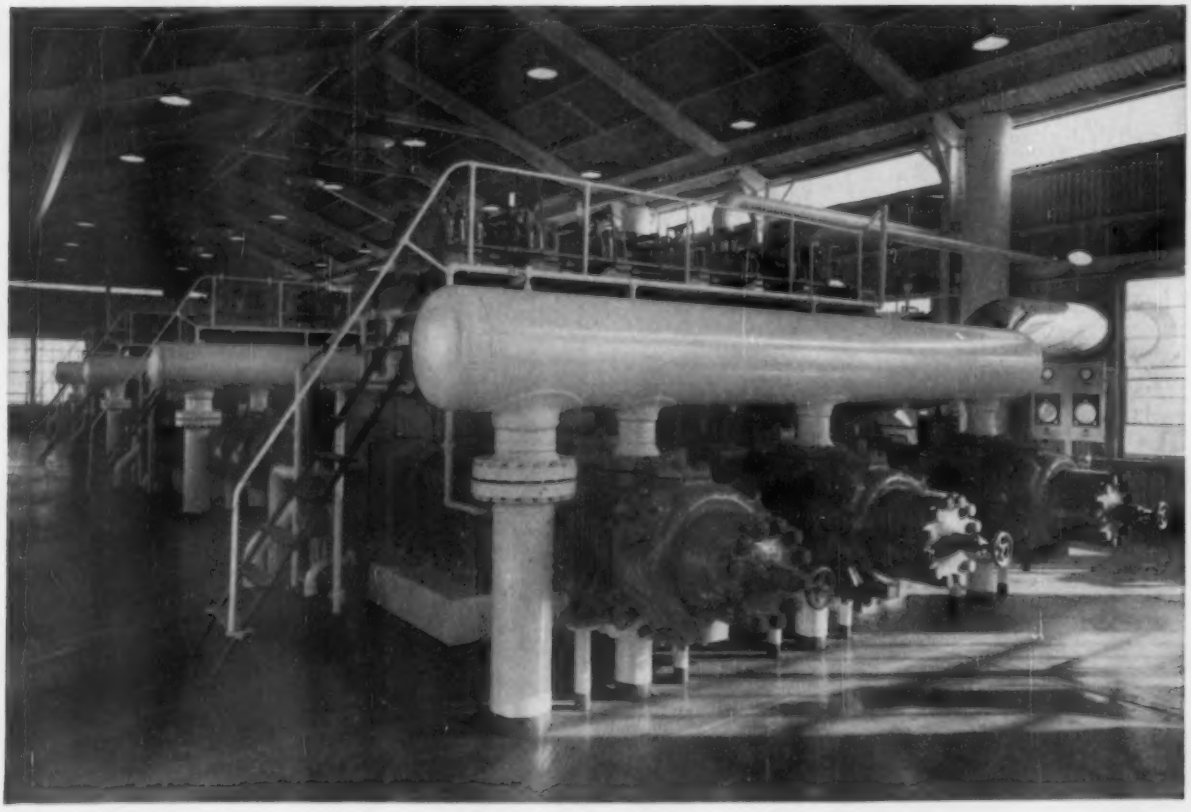
first in drill stem testing

HOUSTON, TEXAS

LONG BEACH, CALIFORNIA • CALGARY, CANADA

FORMATION AND CASING TESTING
JOHNSTON

HORSE



Since Clark introduced the world's first 2-cycle turbo-supercharged gas-engine-driven compressor in 1953, over 431,000 bhp. of these modern ultra-efficient units have been ordered by industry.

POWER

of Clark Turbo-supercharged Compressors now operating or on order

In the Clark tradition, these TLA and TRA units don't have to be babied or pampered when the going gets rough. Because they are specifically designed for turbo-supercharging rather than being beefed-up lightweights, they possess the stamina to back you up under the most difficult load conditions. Seven years of experimental and development work *prior* to their introduction make their outstanding performance possible.

The TLA-TRA have been field-proved by over 1,000,000 compressor hours on stream.

For modern, efficient, trouble-free compressor horsepower at its best, choose a Clark TLA-TRA. Seven models from 1100-3400 bhp.

CLARK BROS. CO., OLEAN, NEW YORK
One of the Dresser Industries
Offices in Principal Cities Throughout the World

CLARK

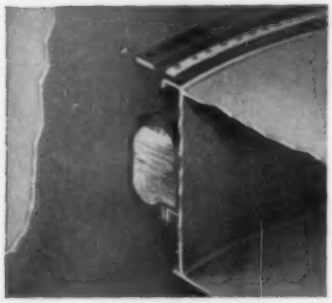
Turbo-Supercharged Compressors

every oil operator wants to know

HOW TO PREVENT LIGHTNING FIRES IN TANKS

the answer is now available

USE HAMMOND TUBESEAL* FLOATING ROOFS!

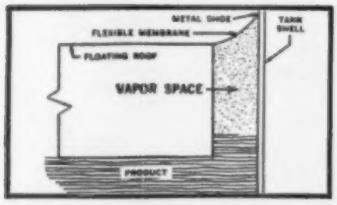


TUBESEALS are made lightning-proof with their exclusive electric conductor weather seal.[1] This specially compounded synthetic rubber, extending continuously around the entire perimeter, between roof and tank shell, provides an infinite number of contact points. ELABORATE TESTING by an independent laboratory[2] discloses that the seal prevents isolation and collection of static electricity charges, providing a continuous conductive surface with large current carrying capacity. Induced charges from lightning are immediately dissipated and fires are prevented. There are no mechanical contacts to cause sparking.

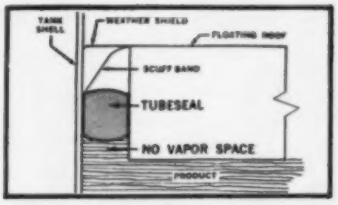
WITHOUT VAPOR THERE CAN BE NO FIRES **. . . the inherent design and construction of Hammond Tubeseals eliminates space between roof, shell, and liquid; thus, there is no room for vapor to form . . . no vapor . . . no fires . . . no evaporation . . . no corrosion!**

Introduced to the oil industry late in 1955, the Hammond Tubeseal found immediate favor with oil companies all over the world . . . there are now more than 200 installations in operation and building. A measure of their conservation values and fireproof features is illustrated by their record of repeat orders from satisfied users—one large oil company, after several test installations, re-ordered more than a score of Tubeseals. The same story of satisfaction exists wherever a Tubeseal is in operation.

Write for bulletin TS



CONVENTIONAL FLOATING ROOF tank has space below flexible membrane where air-vapor mixtures form. Because metal shoe and membrane cannot be absolutely gas tight, vapor is constantly escaping. This condition causes excessive corrosion, may also result in rim fires from lightning or other source.



HAMMOND TUBESEAL FLOATING ROOF entirely eliminates every space where air-vapor mixtures can form. Hammond Tubeseal completely fills space between product surface and roof seal, so that corrosion is stopped (even for sour crudes), and vapor cannot form—hence cannot ignite or be lost.

THE HAMMOND TUBESEAL
for new or old floating roof tanks,

FEATURES

- **lightning and fire proof construction**
- **no moving parts**
- **no mechanical maintenance**
- **climate-proof**
- **non-corrodible**
- **can operate to bottom of tank or above the top**
- **no vapor space below the seal**
- **entire circumference has tight seal under pressure at all times**
- **longer working life expectancy**

*Patented [1]patent pending [2]names on request

HAMMOND TUBESEAL — THE MOST EFFICIENT AND POSITIVE SEAL KNOWN

HAMMOND IRON WORKS

WARREN and BRISTOL, PA. • PROVO, UTAH • CASPER, WYO. • BIRMINGHAM, ALA.

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WARREN, PA. • BRISTOL, PA. • ARLINGTON, VA. • GREENVILLE, S. C. • BIRMINGHAM, ALA.
SAPULPA, OKLA. • PROVO, UTAH • CASPER, WYO. • LOS ANGELES 57, CALIF. • HAVANA • MEXICO CITY
"TIPSA," BUENOS AIRES • CAIRO, EGYPT • PORT-AU-PRINCE, HAITI • LIMA, PERU

Licensees: CALIFORNIA, CANADA, ENGLAND, BELGIUM, GERMANY, ITALY, FRANCE, AUSTRALIA, JAPAN

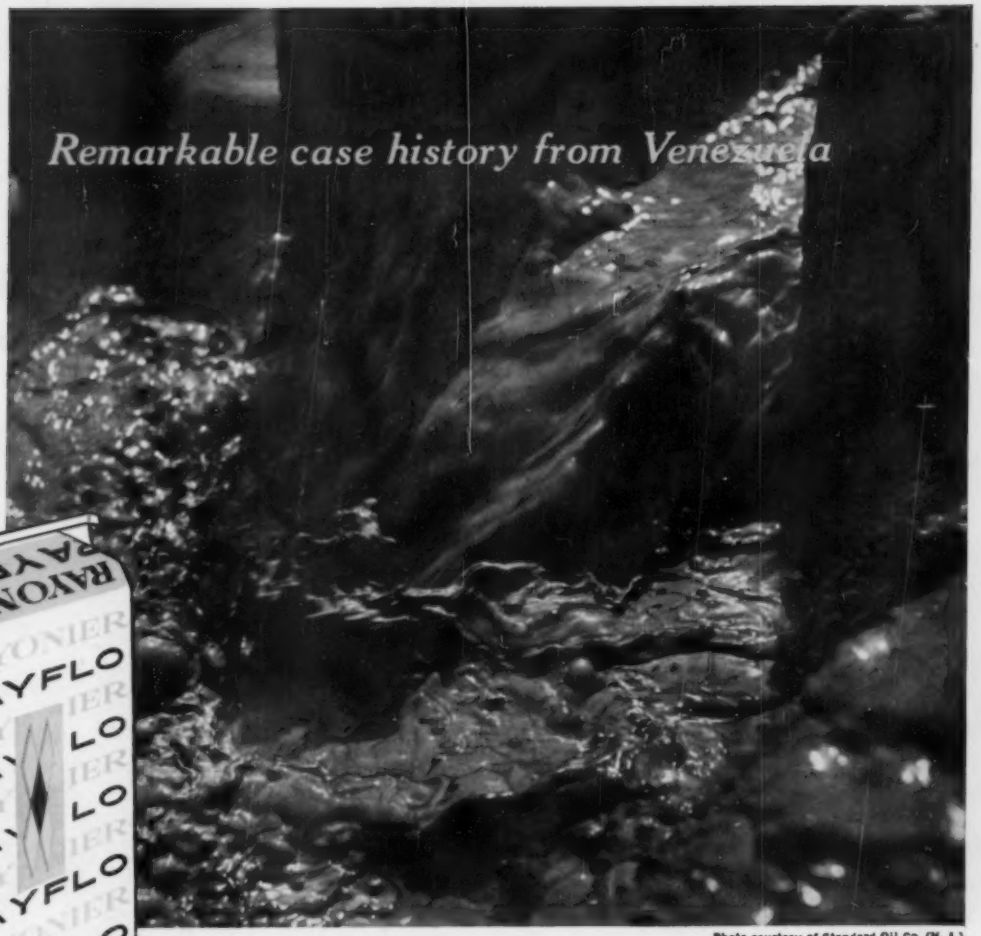
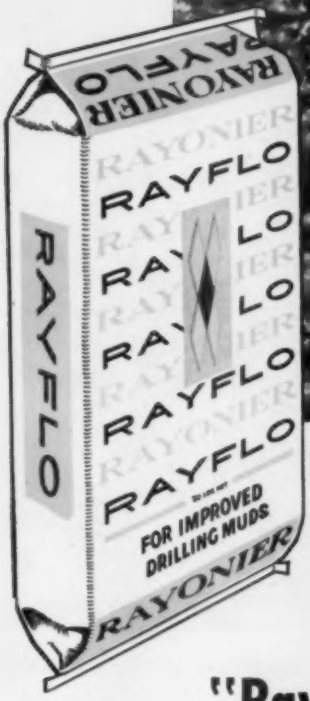


Photo courtesy of Standard Oil Co. (N. J.)



Here's what we claim for Rayflo, our versatile oil well drilling mud dispersant:

water soluble · saves starch · high temperature stability · effective in lime muds · effective without caustic · requires less CMC · resists salt contamination · permits smooth break-over · uniform and completely consistent

We also claim Rayflo to be a complete replacement of organic thinners. Case histories from every major oil producing area are proving these claims. For example, from one company alone in Venezuela comes the report that . . .

"Rayflo saved 238,300 lbs. of thinner!"

A major oil company operated 27 rigs during a twelve month period, consumed 781,950 lbs. of organic thinners other than Rayflo.

The following year, with the same number of rigs in operation, drilling essentially the same footage, only 543,650 lbs. of thinner was used. Why? Because a substantial amount of Rayflo was used, solving a tough sloughing shale problem.

Using Rayflo, the amount of thinning agent saved was 238,300 lbs. or a husky 30%!

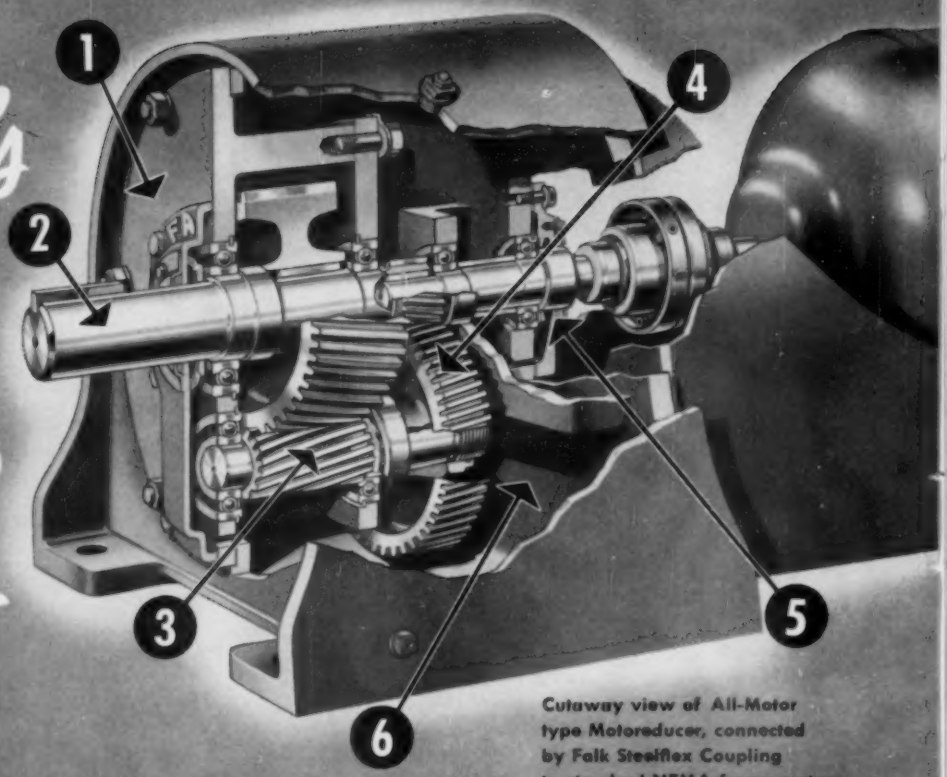
Rayflo is fully credited with effecting this uncommon saving. As a result, this major oil company is now using essentially 100% Rayflo as its dispersant for efficient, economical control of viscosity, gel strength and fluid loss.

Want more details on this case history? They are available without cost or obligation. On company stationery write to: George E. Durkee, Rayonier Incorporated, 161 East 42nd Street, New York 17, N. Y.

RAYONIER *silvichemistry*

Executive and General Sales Offices: 161 East 42nd Street, New York 17, N. Y.

Here's the inside story—



Cutaway view of All-Motor type Motoreducer, connected by Falk Steelflex Coupling to standard NEMA frame motor

WHY Falk Motoreducers give better service—have longer life

Here is the "inside story" behind the all-steel All-Motor type FALK Motoreducer's universal reputation as a gear drive unmatched in quality, efficiency, dependability, ease of maintenance and long life. These "In-built" factors are—

1 **ALL-STEEL HOUSINGS.** Rugged, strong, rigid...all parts are manufactured from heavy steel plate, formed and welded in the Falk Weld Shop.

2 **LARGE OVERHUNG LOAD CAPACITY.** Large shafts, oversize bearings...rigid mountings with wide bearing spans to handle maximum applied loads.

3 **PRECISION GEARING.** Heat-treated alloy steel gearing, precision cut and shaved after heat treatment to eliminate distortion. Quiet, crown-shaved pinions.

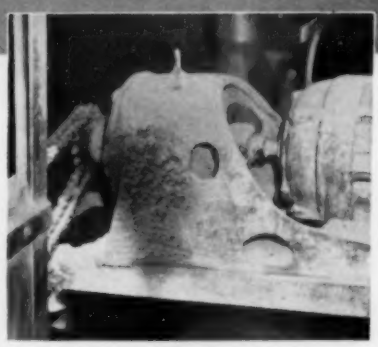
4 **EXTRA-CAPACITY GEARING.** Special extra-capacity gear-tooth form with larger contact area gives greater strength, higher load-carrying capacity.

5 **SEALED HOUSINGS.** Splashproof, dustproof, oil-tight construction. Dual closures and one-way vents keep oil in, dust and moisture out.

6 **POSITIVE LUBRICATION.** Large sump capacity...oiltight construction assures clean lubricant...revolving elements lubricated by direct dip.

When you buy or specify the All-Motor type FALK Motoreducer, you get all these—plus the tremendous advantage of full interchangeability of motors. Switch motors as desired—use any make, style or type of standard foot-mounted motor within the unit's AGMA rating—with a minimum of difficulty or "down time."

Available in sizes up to 75 hp—*with or without motor*—from convenient factory, field or distributor stocks, from coast to coast. **Write for Bulletin 3100.**



60,000 HOURS WITHOUT A FAILURE!

Sixty thousand hours is a lot of hours—but the FALK Motoreducer in the unretouched photo above has served that long without failure or need of repair.

This 3 hp unit is one of over 60 FALK Motoreducers in daily service in an Eastern plant of a large milling company, whose president says, in part:

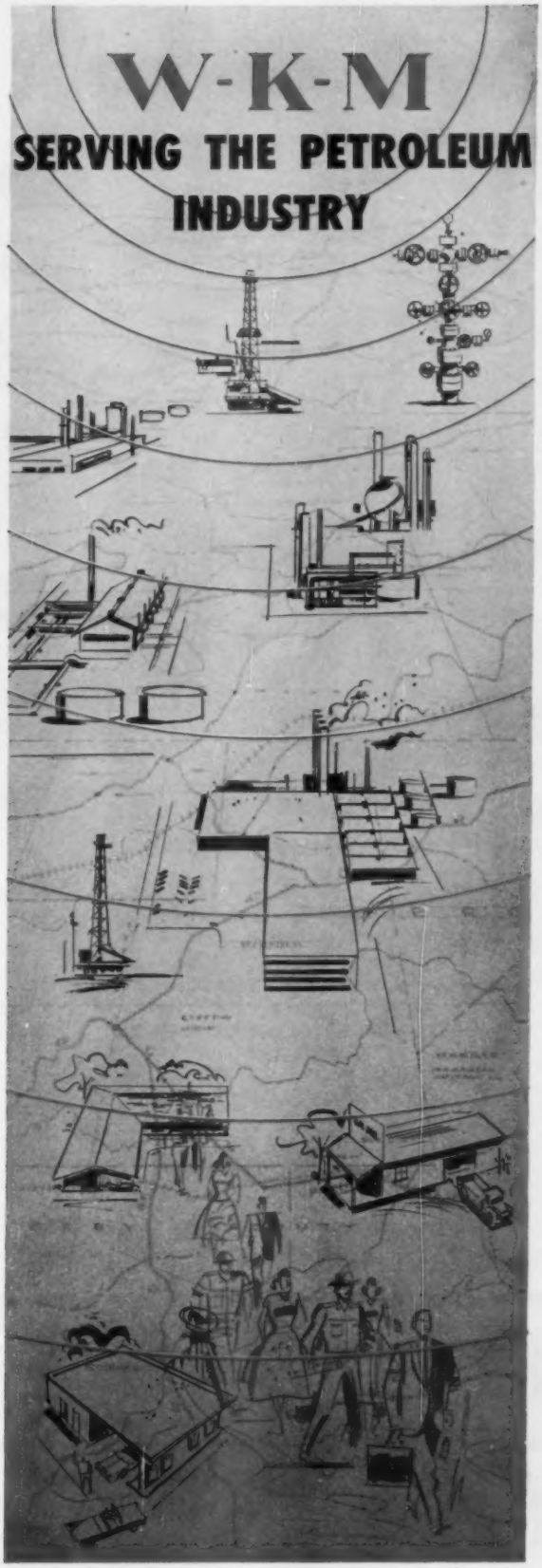
"One of the main advantages of FALK Motoreducers is their adaptability to any motor. Reducers and motors can be easily interchanged.... Our service records confirm the wisdom of our choice of FALK equipment as our standard."

FALK ...a good name in industry

THE FALK CORPORATION, MILWAUKEE, WISCONSIN

MANUFACTURERS OF

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining



...*From Rig to Retail*

W-K-M products serve the petroleum industry every step of the way — they control and direct the flow of petroleum more efficiently, more economically, at the well; in the field; in refineries, processing and recycling plants; all along the pipelines; in compressor and pumping stations; and in distribution systems for homes, industries and even the corner filling station.

Whatever the phase of the industry you are in, you will find a W-K-M product to meet your requirements. Write W-K-M for further information to help you select the products that apply to your operation.

W-K-M ® Through-Conduit Gate Valves for oil field service 2" to 4", 500 psi to 15,000 psi working pressures.

W-K-M Process Valves 2" to 30", ASA 300 lbs., 400 lbs., 600 lbs., 900 lbs., 1500 lbs.

W-K-M ASA Through-Conduit Gate Valves 2" to 30", ASA 300 lbs., 400 lbs., 600 lbs., 900 lbs., 1500 lbs.

ACF ® Lubricated Plug Valves with round and rectangular ports ½" to 30", 125 lbs. to 500 lbs. working pressures WOG.

ACF Ball Valves ½" to 6", 150 lbs. to 400 lbs. working pressures WOG.

W-K-M Tubing Slips and Spiders for strings ¾" to 3" O.D. and depths to 15,000 feet.

KEY ® Return Bends.
Available in complete range of sizes, shapes, styles, temperature and pressure ratings.

KEY-KAST Alloy Steel Welding Fittings in tees, wyes, elbows, laterals, reducers, as well as special shapes.

KEY-TITE Waterproof Pipe Joint Compound for lines carrying water, gas, low-pressure steam.
KEY Graphite Paste for lines carrying oil, gas, high-pressure steam.

5718

W-K-M
DIVISION OF ACF INDUSTRIES INCORPORATED

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Struthers Wells

STOCK Heat Exchangers Save you money!

Code Equipment at Production Prices

Struthers Wells standard stock heat exchangers have secured a wide acceptance in the process industries.

The illustration shows a partial view of units currently in stock. Equipment is available from stock in sizes from 20 to 300 square feet of surface—including fixed tube sheet, floating head and U-tube units.

Condensers, coolers, heaters, and reboilers can be supplied in single and multi-pass tube arrangement.

Standard heat exchanger construction includes materials of carbon steel, non-ferrous alloy, and stainless alloys Type 304 and Type 316. Equipment meets highest construction standards, including ASME Code and TEMA Class A.

Standardization of design and quantity production enables us to offer this equipment at a very reasonable cost.

Price sheets and standard data are available on request; please address us on your letterhead.

STRUTHERS WELLS PRODUCTS

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Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

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BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

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Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

ANY SIZE AVAILABLE FOR QUICK DELIVERY

STRUTHERS WELLS Corporation

Struthers Wells

WARREN, PA.

Plants at Warren, Pa. and Titusville, Pa.

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See them Now!

Industry's MOST WANTED line of GENERAL PURPOSE VALVES

FOR PETROLEUM REFINERIES
CHEMICAL PLANTS • POWER PLANTS

Write for Supplement No. 1 to Catalog F-9

Address Dept. 24A-FO

MOST WANTED — that's right — because the G P line includes gate, globe, and angle type valves having seats faced with **HAYNES STELLITE*** alloy or other hard facing alloys for greater seat-wear resistance . . . at no extra cost!

Hard faced seats, in combination with precision finished, selectively hardened discs and wedges give these valves amazing resistance to erosion, corrosion and galling. That's why they are setting new standards of performance in steam, water, oil, or gas services at the recommended pressures and temperatures.

Get longer, drop-tight, service life with minimum maintenance by specifying Vogt G P Valves. Available in a complete range of sizes from ¼" to 2" and rated 800 pounds at 850°F. and 2000 pounds at 100°F.

HENRY VOGT MACHINE CO.
P. O. Box 1918—Louisville 1, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati

Vogt

GENERAL GP PURPOSE

Vogt FOR BETTER VALVES

DROP FORGED STEEL

VALVES

*Trade-Mark of Union Carbide and Carbon Corporation

A 7500-foot Tiger Brand line was used on this rig and was cut back 69 feet each time to get maximum service from the rope.

gets heap big run

of 120,000 ton-miles from one 7500-foot Tiger Brand Wire Rope

Joe Blackman, American Wire Rope Specialist, and E. J. Stufflebeam, tool pusher, check a piece of wire rope for wear after the 120,000 ton-mile run.

Drilling was tough in this area and vibration severe, but the Tiger Brand lines withstood it without trouble.

This is the best ton-mile record made in the Eola Field according to Mr. E. J. Stufflebeam, tool pusher on the Big Chief Drilling Company's Rig No. 29 in Garvin County, Oklahoma. He goes on to say, "I've run experiments on various lines, including high strength, but we've got better runs from Tiger Brand than any other ropes we ever used. One reason is that American Steel & Wire sends a field man around who checks what is happening and offers good suggestions on how to improve wire rope life."

The wire rope used on this rig was American Tiger Brand, 1¼-inch, 6x19 Monitor Excellay with wire core . . . the best drilling line you can buy. Write for complete information.

AMERICAN STEEL & WIRE
DIVISION
UNITED STATES STEEL, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS AMERICAN TIGER BRAND WIRE ROPE

Excellay Preformed

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American Steel & Wire
5E-117, Rockefeller Building
Cleveland 13, Ohio

☐ Rush me one free Tiger Brand Ton-Mile Calculator.
☐ Have your representative call to show me how this calculator can help me cut line costs.

Name .....
Firm .....
Address .....
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UNITED STATES STEEL

Engineering Progress Report

FROM UNION CARBIDE CHEMICALS COMPANY

Side Stream Distillation Reduces Cost of Gas Sweetening Operations

Control monoethanolamine contamination by eliminating foreign materials

Monoethanolamine reacts with weak acids such as hydrogen sulfide and carbonic acid at ambient temperatures to form salts. Then, these salts decompose when heated to the boiling point of water, liberating the acidic gases and freeing the monoethanolamine for recirculation to pick up more acid gas. This provides an economic cyclic process for absorbing these undesirable materials from a gas stream. Because of this, practically all gas sweetening in the United States is accomplished by means of the ethanolamines. Union Carbide Chemicals Company's Technical Service Department is continually engaged in research designed to give better engineering service to users of CARBIDE's ethanolamines.

MOST UNITS ARE TROUBLE-FREE

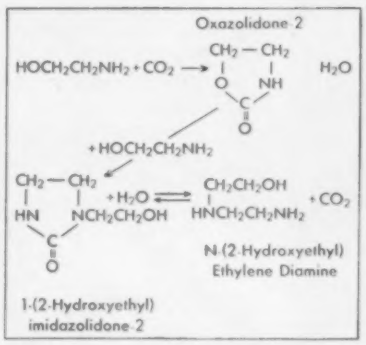
Most of these plants have operated for years without difficulty. However, experience with both aqueous-amine and glycol-amine solutions shows that in some plants the solution gradually loses capacity to absorb acidic gases and may become corrosive.

Research has shown that monoethanolamine contamination can be controlled by a simple side stream distillation system which removes foreign materials and amine degradation products. Thus, sewering can be avoided.

FORMATION OF AMINE DERIVATIVES

Examination of used aqueous and glycol-amine solutions led to the isolation and identification of two monoethanolamine conversion products, namely, 1-(2-hydroxyethyl) imidazolidone-2 and N-(2-hydroxyethyl) ethylene diamine.

It was found that this reaction actually takes place at a very slow rate in some plants handling carbon dioxide. A similar reaction



yielding similar products does not occur when only hydrogen sulfide is present.

EFFECT OF AMINE DERIVATIVES

Formation of imidazolidone reduces the effective monoethanolamine concentration and increases solution viscosity. High concentration may aggravate precipitation of residues in equipment. N-(2-hydroxyethyl) ethylene diamine will pick up acid gases, but release them only with difficulty. The acid gas salt of this stronger amine may contribute to plant equipment corrosion.

DEGRADATION PRODUCTS REMOVED BY SIDE STREAM DISTILLATION

Commercial experience proves that it is possible to remove the imidazolidone from fouled plant solutions by side stream distillation at atmospheric pressure. Batch-wise operation handling approximately 1 per cent of the circulated solution has been successful. Vacuum distillation equipment has been equally successful in the case of glycol-amine solutions.

While the substituted ethylene diamine can be efficiently removed in aqueous monoethanolamine systems, it can not be removed from diethylene glycol-monoethanolamine mixtures as its boiling point is within a few degrees of that of diethylene glycol.

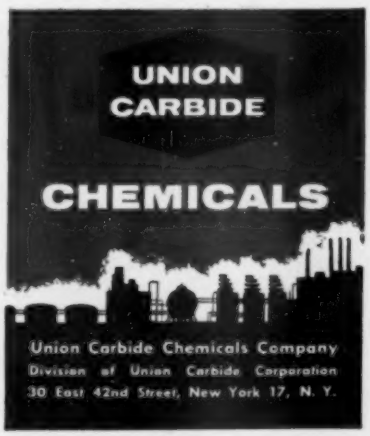
However, the imidazolidone and diamine are in equilibrium. Therefore, reduction of the imidazolidone concentration causes the diamine to revert to imidazolidone. This results in an ultimate removal of both the imidazolidone and the diamine.

In addition, side stream distillation also removes inorganic salts, organic materials with boiling points higher than monoethanolamine, and heat stable monoethanolamine-acid reaction products.

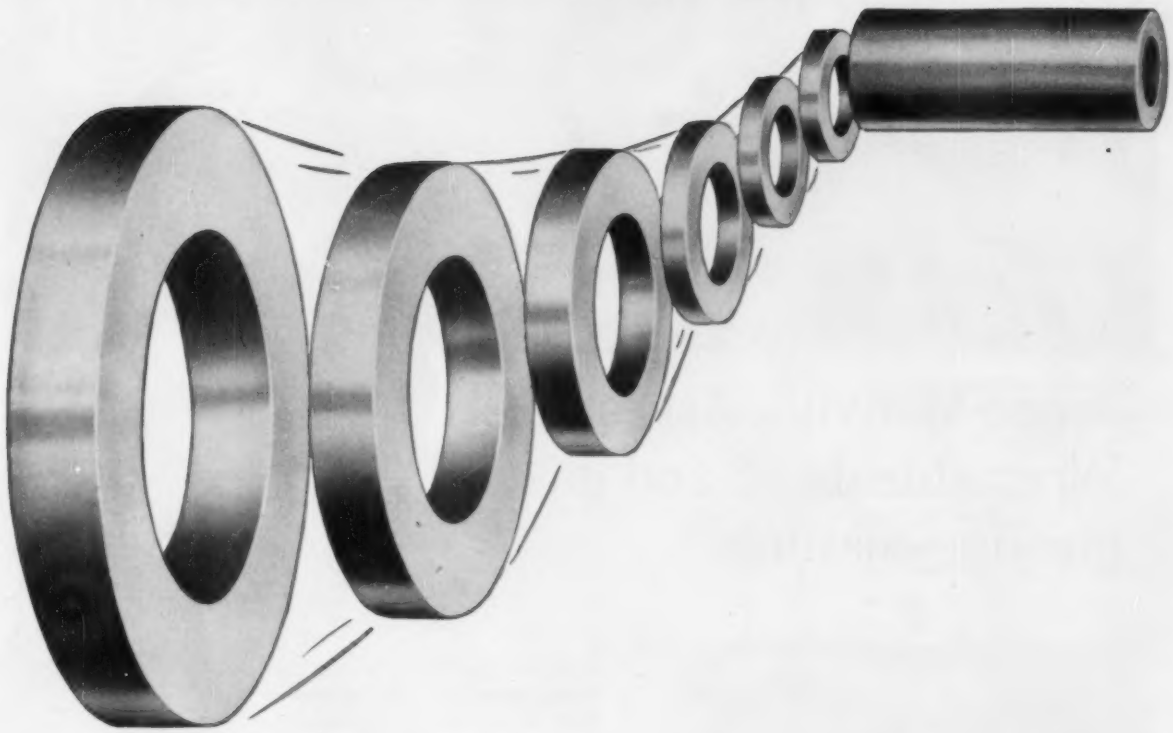
TECHNICAL SERVICE AVAILABLE

CARBIDE offers many technical services to the gas conditioning industry. If you have a gas treating problem, call the nearest CARBIDE technical representative or write Union Carbide Chemicals Company, Department B, 30 East 42nd Street, New York 17, New York.

"Union Carbide" is a registered trade-mark of Union Carbide Corporation



How to add machining capacity without adding machines



...and save money on your steel!

ARE you making hollow parts, or boring out solid bar stock? Timken® seamless steel tubing can eliminate that unnecessary and costly boring operation—because Timken seamless steel tubing comes with *the hole already there.*

By cutting out this needless operation, you free screw machine stations for other jobs. You get increased machining capacity without adding machines. More than that, you pay only for the steel you use—without wasting solid bar stock centers. And of course you speed up your hollow part operation by starting with Timken seamless steel tubing; *finish* boring can become your first production step.

Timken seamless steel tubing is made by a piercing process which is basically a forging operation. So you get fine forged quality: uniform spiral grain flow for greater strength, and refined grain structure. This quality is maintained from heat to heat, tube to tube and order to order. The Timken seamless steel tubing recommended by our engineers as *your* most economical tube size will be guaranteed to clean up to your finished dimensions.

The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

See the next Timken Televent hour, "The Innocent Years" over NBC-TV, Thursday night, November 21st.

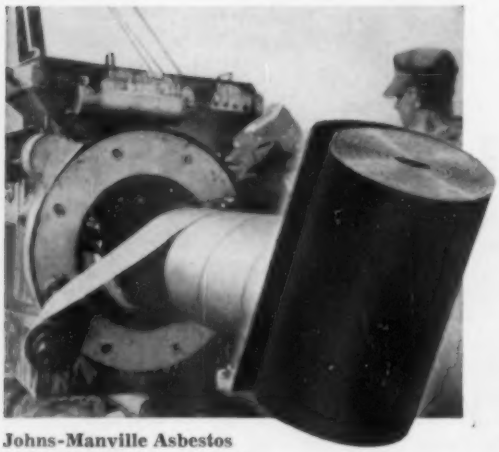
TIMKEN *Fine Alloy* STEEL

TRADE-MARK REG. U.S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

Like the "dillo's" tough shell that shields him so well...

Johns-Manville Asbestos Wrap shields oil and gas pipeline coatings



Johns-Manville Asbestos Felt is available in 3 types for field application or mill wrapping:

#15 Asbestos Felt—the high-strength, uniform asbestos wrap that has given superior protection to pipe coatings for more than 30 years—under the most severe soil conditions.

#15 Transhield®—heavyweight asbestos felt with parallel glass reinforcement for high tear strength.

#8 Transhield—standard-weight asbestos felt with parallel glass reinforcement—for low-cost protection against average soil conditions.

J-M Asbestos Wrap provides the strong protection a strong coating deserves and needs. It offers the most effective single protection against damage—prolongs the working life of the pipeline coating. Here's why:

Asbestos is an ageless mineral . . . the fibres are strong and tough—cannot rot or decay. As used in J-M Wraps, the asbestos fibres are felted, then impregnated with a cold tar or asphalt saturant to form literally a flexible covering of stone. Like the "dillo's" tough shell that shields him so well—the enduring, "stonelike" J-M Asbestos Wrap shields pipeline enamels from earth loads, soil stress, and other forces that weaken coatings and permit corrosion of the pipeline.

Invite one of our engineers to show you the results of the three-year, extensive test program on "Pipe Line Coatings and Wrappers." Write to Johns-Manville, Pipe Division, 22 East 40th Street, New York 16, N. Y.

✓ STRONG PROTECTION • PROVEN PERFORMANCE
RESISTANCE TO SOIL STRESS AND DEFORMATION
HIGH-SPEED APPLICATION • LONG-TERM INVESTMENT
SIMPLIFIES CATHODIC PROTECTION SYSTEMS
REDUCES HAZARD • INCREASES SAFETY

Johns-Manville PRODUCTS FOR PIPELINE PROTECTION

With Magcobar on your well ...

you can cut the time per well... the cost per foot

You can see the effect each day of a faster rate of penetration in the drilling report. Part of the credit for faster penetration goes to the quality of the mud program.

When you pay close attention to the mud circulation rate, circulation pressure, and the characteristics of the mud: viscosity, gel strength, weight, etc., you can get maximum effect from high rotary speeds and high weight on bit.

For example, right now in many areas Magcobar is reducing costs by increasing drilling rates with the use of low solids oil emulsion muds. Such a program results in fewer rock bits, fewer round trips, and faster penetration.

You'll find the assistance of the Magcobar team, working and planning with you, will help to keep your rig drilling at maximum speed and efficiency. Plan now to make full use of Magcobar on your next well.

Magnet Cove Barium Corporation
Houston, Texas

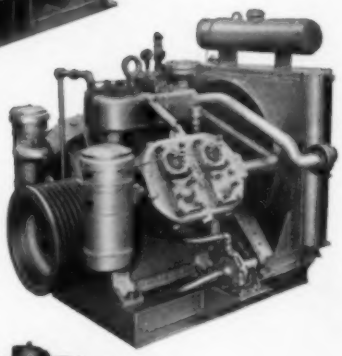
Magcobar®
Complete
DRILLING MUD SERVICE

57-104

What's new in the oil fields . . .

a report on Gardner-Denver Engineering Foresight

A giant addition to the famous Gardner-Denver mud pump line—the 1250 h.p. GX-GXH—features counterbalanced eccentric . . . threaded fluid cylinder locks and rings.



Engineered for air drilling service, these Gardner-Denver compressor units meet capacity, pressure and air temperature requirements.

One-piece cast steel fluid end on the new Gardner-Denver PE-5 130 h. p. well servicing pump, another high-pressure pump in the Gardner-Denver line.

And a new 30 h.p. waterflood pump—Model PG-3—makes seven Gardner-Denver pumps available to meet all waterflood or salt water disposal requirements.

Another great Gardner-Denver well servicing pump—310 h.p. Model PA-8K—with underslung jackshaft for compact installation on well service trucks.

And look to Gardner-Denver for engineering leadership in gas compressors, for boosting or repressuring . . . oil line pumps . . . pipeline drills . . . rotary portable air compressors . . . air hoists and air tools . . . rig-mounted air compressors. Write for bulletins, or call in your Gardner-Denver specialist.

ENGINEERING FORESIGHT—PROVED ON THE JOB
IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

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Gardner-Denver Company, Quincy, Illinois—In Canada: Gardner-Denver Company (Canada) Ltd., 14 Curity Avenue, Toronto 16, Ontario— Gardner-Denver Export Division, 233 Broadway, New York, N. Y.—Oil field offices: Dallas, Houston, Tulsa, St. Louis, Los Angeles, New York, Pittsburgh, Denver, New Orleans, San Francisco, Kansas City, Winnipeg, Edmonton—Republic Supply Company, P. O. Box 2137 Terminal Annex, Los Angeles 54, Calif.

RELIABLE IGNITION *At Hand!*

for OIL INDUSTRY ENGINES . . .

AMERICAN BOSCH MAGNETOS

Packed with electrical energy, American Bosch Magnetos kick off FAST — supplying the instantaneous sparks that start Drilling, Pumping, and Pipeline engines FASTER — and keep them running LONGER — even under the toughest working conditions! That's why they're installed as original equipment by so many leading engine manufacturers for Oil Industry services.

Your engines can have this reliable ignition — high or low tension replacements are available for practically every engine. Precision engineering and rugged construction assure full-time, trouble-free operation. Write directly, TODAY; find out how American Bosch Magnetos can improve your engines and operations. American Bosch, Springfield 7, Mass. A Division of American Bosch Arma Corporation.

AMERICAN BOSCH

Fastest, safest, most accurate wire line services in the field!

NEW BJ Service 300-H Wire Line Trucks

1 **Unlimited mobility.** Four Wheel Drive chassis with heat-treated frame... high horsepower engine... 130-gallon gasoline capacity... all combine to get the 300-H to the job *on time*, regardless of terrain or location.

2 **Separate control compartment,** fully insulated, wide view window. Maximum visibility and comfort for operator and observers.

3 **Separate hoist engine** gives uninterrupted power.

4 **Hydra-Matic winch drive.** Line runs at optimum gear ratio under all loads.

5 **Fingertip controlled brake.** Safe, will not self-release.

6 **BJ electronic weight indicator,** proved for 10 years as the most accurate and sensitive in the oil patch.

7 **BJ calibrated sheave measuring system,** mounted inside truck.

8 **Inter-communication system** connects shooter and floor crew.

9 **2000-W, 110-V generator** assures ample power, even for radioactivity logging.

10 **Gun racks** have capacity for up to 50 feet of shooting interval.

11 **BJ safety firing circuit.** Warning devices, operating for predetermined interval before firing, assure maximum safety.

12 **Complete instrumentation** for BJ sonic, magnetic collar locator, weight indicator, measuring system and shooting circuit.

WRITE for illustrated bulletin and information on your specific needs.

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General Offices and Laboratory — Long Beach, California

Stations Throughout California, Rocky Mountain and Permian Basin Areas

CHEMICAL PROCESS BJ Service

SUBSIDIARY OF BORG-WARNER CORP.

Chemical Process

General Offices and Laboratory — Breckenridge, Texas

Stations Throughout the Mid-Continent Area

Your choice of normal or low starting current...

with Performance-Rated

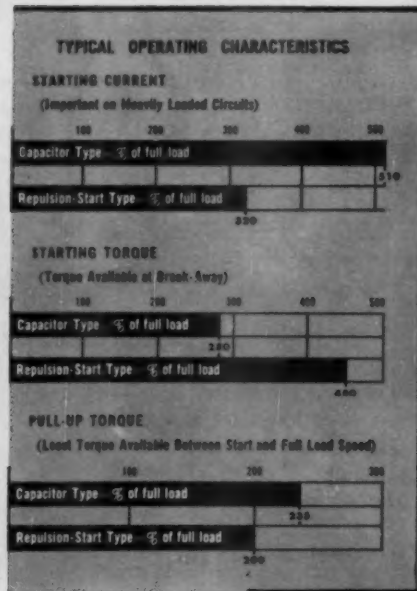
Century

SINGLE-PHASE, HIGH TORQUE MOTORS FOR OIL FIELD USE

Capacitor Motors... ⅛ to 20 H.P. provide high starting torque, high pull-up torque and require normal starting current. They are available in drip proof, dust proof and explosion proof enclosures.

Even if you have severe starting current limitations, you can select the torque you need for sure starts and smooth pull-up to speed from the Century Performance-Rated Single-Phase line (see bar chart below for operating characteristics of two types of Century Single-Phase Motors).

Whatever Your Oil Field Motor Job... there's a Century Motor Performance-Rated to handle it with top effectiveness. For added outdoor protection, Century *Weather-Gard* Motors have openings screened to keep out rodents. Check with your supply store, or Century branch office.



Repulsion Start, Induction Motors (type RS)... ½ to 7½ H.P. provide very high starting torque, yet require unusually low starting current. They are available in drip proof and splash proof enclosures.

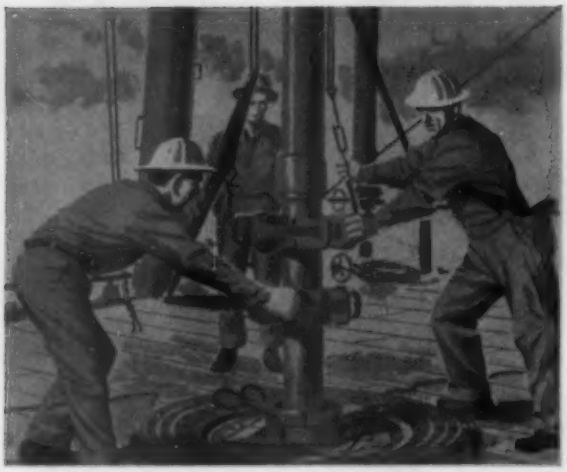
Performance-Rated© Motors ⅛ to 400 H.P.

CENTURY ELECTRIC COMPANY

CE-52

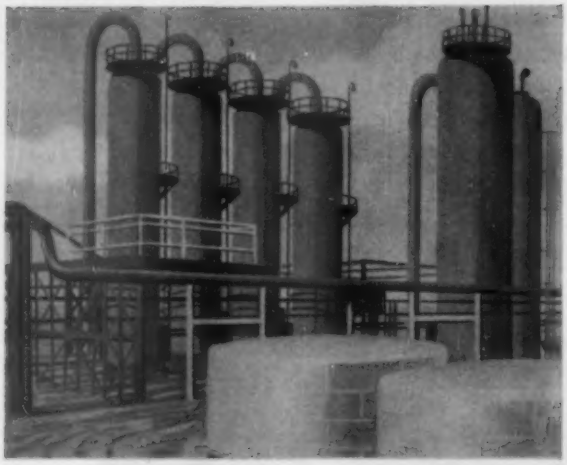
1806 Pine Street, St. Louis 3, Missouri • *Offices and Stock Points in Principal Cities*

Toward Deeper Drilling...More



RUGGED MUD CONDITIONERS THAT BENEFIT FROM NEW CYANAMID RESIN AND POLYMER DEVELOPMENTS

CYPAN® Drilling Mud Conditioner . . . a high molecular weight acrylic polymer for dependable water loss control.



PROVED HIGH-PERFORMANCE CATALYSTS THAT ARE PRETESTED IN OPERATING REFINERIES

Cracking

AEROCAT® Fluid Cracking Catalysts . . . microspheroidal catalysts, both 13% and 25% alumina types, available in several ranges of particle size distribution.

Reforming

AEROFORM® PHF Platinum Reforming Catalysts . . . platinum promoted alumina base

AEROFORM® MS-1 Fluid Hydroforming Catalysts . . . a spray-dried microspheroidal molybdena-alumina.

Desulfurization

AERO* HDS Catalyst . . . an extruded cobalt-molybdena for sulfur and nitrogen reduction in conjunction with hydrogenation.

Ammonia and Hydrogen Production

AERO* Catalyst FM-2 for ammonia synthesis reaction.

AERO* Catalyst HI-3 for water-gas shift reaction.

AERO* Catalyst NR-1 and NR-2 for reforming methane, ethane or natural gas.

STABLE, HARD-WORKING ANTIOXIDANTS AND LUBE ADDITIVES THAT GIVE NEW LIFE SPANS TO FUELS, MOTOR OILS

AEROLUBE® Lubricating Oil Additives . . . in a wide formulation range for inhibitor-detergency action in all types of crankcase oils.

AEROLUBE® 93-C . . . a concentrated zinc dithiophosphate inhibitor with superior anti-wear characteristics.

AERONOX* Antioxidant 153 and 9010 . . . hindered phenol type for oils, greases and fuels.

AERONOX* MB Methane Base Antioxidant Inhibitor . . . an antioxidant and metal deactivator for special lubricants.

*Trademark

Efficient Refining... Better Oil Products

CYANAMID

teams with the petroleum industry in developing better products

The practical experience of oilmen is part of every catalyst, mud conditioner, antioxidant and additive offered by Cyanamid. Practical product development has stemmed from a working partnership between Cyanamid and petroleum engineers – a sound basis for re-evaluating established products and testing new ones. Result: new and improved products second to none in performance.

Creative research, coupled with volume production, exacting quality control and fast, anxious-to-help technical service, has featured Cyanamid's 50 years of growth as a chemical manufacturer. This product dependability has been serving the petroleum industry for two decades – and can be working for *you*

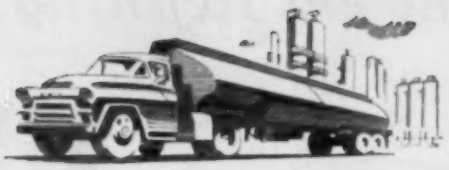
PRODUCT IMPROVEMENTS ARE SPURRED BY CYANAMID'S BROAD, CONTINUOUS RESEARCH

Your product requirements—and the problems of the petroleum industry—are the concern of many skilled, creative laboratory teams at the Stamford Research Laboratories. Basic information is obtained by outstanding research specialists using a full range of modern analytical and testing equipment. Actual operating refinery tests are the final stage in evaluating all these problem-solving products.

AMERICAN CYANAMID COMPANY
REFINERY CHEMICALS DEPARTMENT
30 Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

Eaton 2-Speed Axles keep trucks YOUNG!



Add Extra Thousands of Low-Cost, Trouble-Free Miles

Drivers of Eaton 2-Speed Axle trucks select from *double* the conventional number of gear ratios—pick the gear ratio best suited to road, load, and traffic conditions. Using the RIGHT gear ratio for every condition permits engines to run in their most efficient and economical speed range—reduces stress and wear on engine, transmission, and the axle itself. This reduction in stress and wear keeps trucks on the job and out of the shop, cuts operating and maintenance costs, and adds thousands of miles of low-cost operation to the life of the truck. Whenever a hauling job requires the combination of pulling power and speed, trucks equipped with Eaton 2-Speed Axles do the job quicker at lower cost; they stay YOUNG longer—and are worth more when traded in.

MORE THAN TWO MILLION EATON AXLES IN TRUCKS TODAY!

For Complete Information see your Truck Dealer

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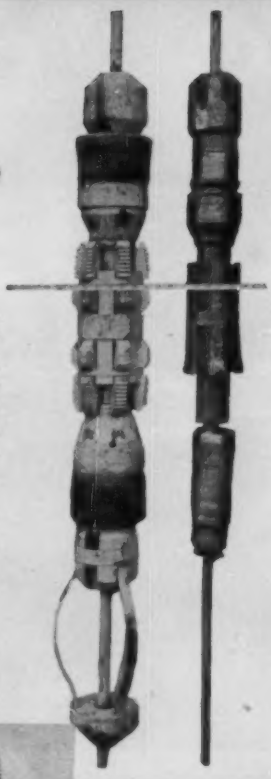
AXLE DIVISION

MANUFACTURING COMPANY

CLEVELAND, OHIO

PRODUCTS: Engine Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Hydraulic Pumps Motor Truck Axles • Permanent Mold Gray Iron Castings • Forgings • Heater-Defroster Units • Automotive Air Conditioners Fastening Devices • Cold Drawn Steel • Stampings • Gears • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

These two actual wash-over jobs demonstrate the faster milling speeds possible with SERVCO Rotary shoes



job no. 1

Using Servco Rotary Shoes to wash over a bridge plug.

A retrievable bridge plug was accidentally cemented inside 7" casing at 6100' with the pay zone at 8500'. Customer requested Servco shoes with a 6⅛" O.D. and 5½" I.D. leaving a 5/16" wall —rather stiff limitations for a shoe when milling slips. As shown in the photograph on the right, Servco shoes had no trouble in washing over the plug. Had the plug not been recovered, re-drill would have cost approximately $100,000.00. Cost of fishing, including rig time, was only $15,000.00.

job no. 2

Servco Rotary Shoe mills over K-Monel collar, reamer and bit in 45 minutes.

Drill pipe became stuck in an open hole at approximately 9000'. After running a free-point indicator, the pipe was backed off, leaving a 6¼" rock bit, a reamer dressed with 6¼" rollers, and a 4¾" O.D. Servco K-Monel Drill Collar in the hole.

A 6" Servco Rotary Shoe dressed with Servcoloy* washed over the K-Monel collar and milled over the reamer and bit in 45 minutes! An actual photograph of the washed-over bit is shown below.

Actual records of these two wash-over jobs and other milling jobs are available.

*The Secret's in the SERVCOLOY**

Servco Rotary Shoes are ruggedly built to take the roughest, most abusive down hole conditions. They will cut cones off bits, cutters off roller reamers, wings from stabilizers, and mill with amazing speed.

Like all Servco milling tools they are dressed with Servcoloy*. This amazing new material utilizes tungsten carbide in a unique way. Hundreds of bits of carbide are suspended in a tough, elastic matrix so that as particles are worn or torn away new particles are automatically exposed. Hundreds of fresh cutting edges are always at work.

*Patents pending.

Why not get the whole story? A new 8-page brochure tells all about Servcoloy and Servco milling tools.

Send for your copy today.

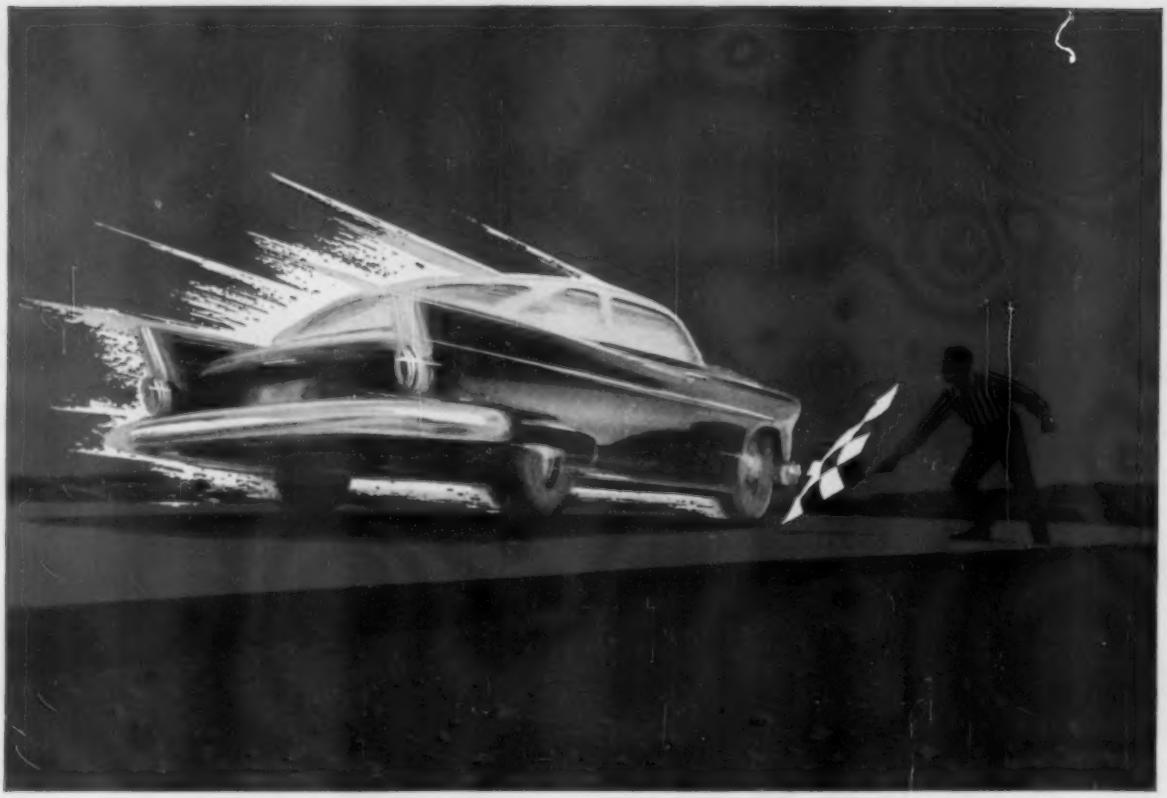
Send inquiries to

SERVCO

4920 Holmes Road, Zone 21 • Houston, Texas

General Offices: Long Beach, California; 904 Security Bldg., Zone 2

Field Offices: VENTURA • BAKERSFIELD • LAFAYETTE • HARVEY • EDMONTON



For those new, higher compression engines...
a new Catforming catalyst

The trend to higher compression engines is here to stay. And wide-awake refiners have to produce fuels to suit these up-to-the-minute engines.

Atlantic is proud to offer an advanced Catforming catalyst designed to economically produce higher octane gasolines . . . *and it can be utilized in your present equipment.* For more information, write, wire or call The Atlantic Refining Company, P. O. Box 8138, Philadelphia 1, Pennsylvania.

Higher gasoline octanes through Pentafining

You can convert the low-quality n-paraffins (C_5, C_6, C_7) in your gasoline pool to high octanes! Pentafining, the process developed by The Atlantic Refining Company, makes it possible. For full particulars, write today to The Atlantic Refining Company, P. O. Box 8138, Philadelphia 1, Pennsylvania.

It's the CATALYST that counts

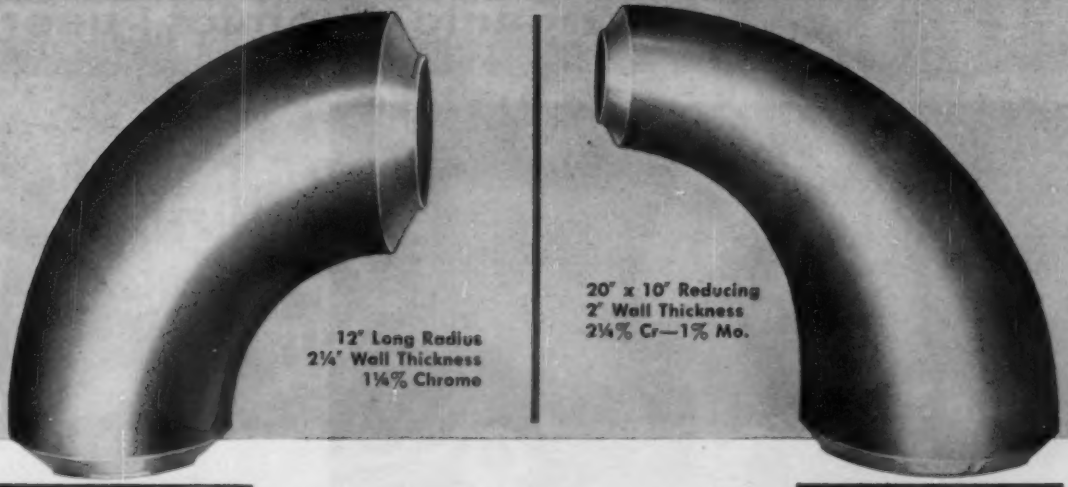
ATLANTIC

LARGER SIZE RANGE

MIDWEST ELBOWS

IMPROVED DELIVERY

HEAVY WALL CARBON STEEL AND ALLOY



STRAIGHT LONG RADIUS 90° ELLS

Nominal Pipe Size	Maximum Wall Thickness
36	1.250
30	2.000
26	2.000
24	1.500
20	1.375
18	2.250
16	2.125
14	1.750
12	2.000
10	2.000
8	1.750
6	1.000
5	.625
4	.750
3	.625
2½	.375
2	.500

These straight elbows can be furnished with LONG TANGENTS at no extra cost. All thicknesses less than those shown above are, of course, available.

The exclusive Midwest method of making all welding elbows from plate instead of tubing gives us a FLEXIBILITY OF MANUFACTURE that is much greater than by any other process. These heavy wall Midwest straight and reducing elbows are available in any material that can be secured as plate. The maximum wall thicknesses for which we now have equipment are indicated by the tables at left and right. And, because it is easier to get plate than tubing, better delivery is another advantage. Still another is the close tolerances inherent in our process.

Quality control goes beyond all code requirements. The longitudinal weld of every heavy wall elbow is completely X-rayed as standard procedure in our method of manufacture.

You will find it to your advantage to send us your inquiries.

REDUCING LONG RADIUS 90° ELLS

Nominal Pipe Size	Maximum Wall Thickness
30	2.000
26	*
24	2.000
20	2.000
18	2.000
16	1.500
14	1.750
12	2.250
10	2.000
8	1.750
6	1.000
5	.625
4	.750
3	.625
2½	.375
2	.500

Reductions to all nominal pipe sizes down to ½ large diameter. All thicknesses less than those shown above are, of course, available.
*Refer to factory.

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Dichloroethylether.

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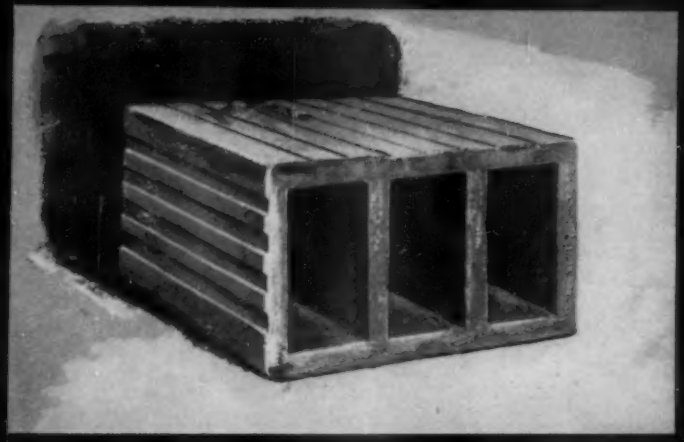

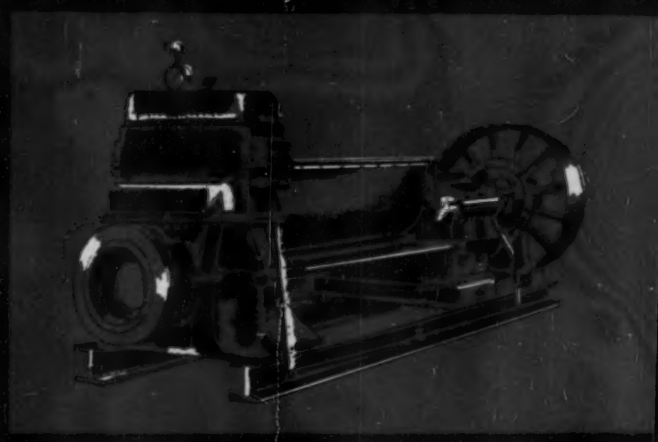

No Margin for Air—
No Margin for Error

ANOTHER DRIVE REQUIREMENT MEETS ITS MASTER

Yes, it's a fact—unless you remove the air from the clay, you get a no-good tile. And whether air is your problem, or not—error is always a problem. And it's never a mistake to come to Master for the right power drive. In every kind of industry, Master customized package drives give you the utmost in flexibility, compactness and performance.

Here, the primary requirement is power—and the husky, big 200 H.P. Master fills the bill year in and year out. Your requirements might be better met by integrating Master components into a single, efficient, compact unit for the right horsepower, right shaft speed and right mounting features. What are they?

A husky 200 H.P. 440 volt squirrel cage induction Master Motor powers this 14-ton De-Airing Brick and Tile Machine with a capacity of over 8000 bricks per hour. Two parallel shafts carrying pug knives work clay, pass it into vacuum chamber with auger cylinders where it is finished and discharged.

Motor Ratings	⅛ to 400 H.P. All phases, voltages and frequencies.
Motor Types	Squirrel cage, slip ring, synchronous, repulsion-start induction, capacitor, direct current.
Construction	Open, enclosed, splashproof, fan-cooled, explosion-proof, special purpose.
Speeds	Single-speed, multi-speed, and variable speed.
Installation	Horizontal and vertical, with or without flanges and other features.
Power Drive Features	Electric brakes (2 types)—5 types of gear reduction up to 432 to 1 ratio. Mechanical and electronic variable speed units—fluid drives—every type of mounting.

MASTER

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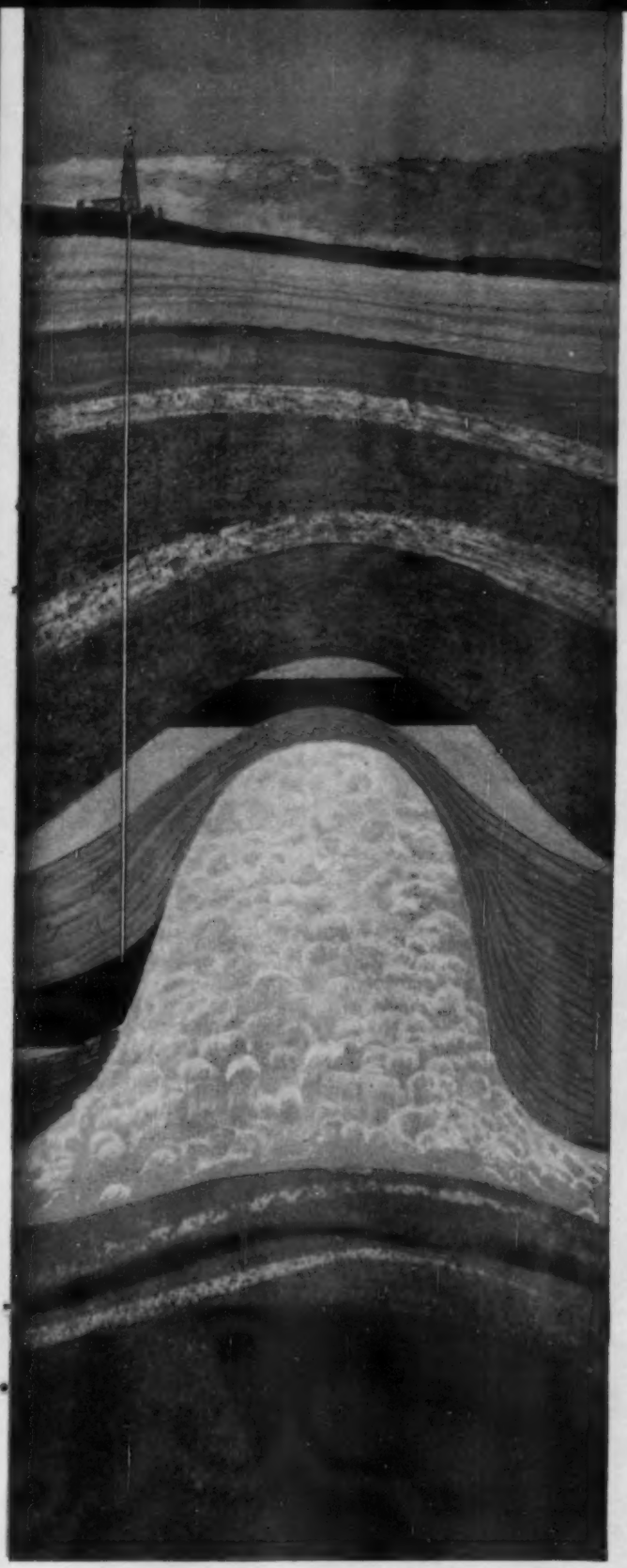
UNITED STATES STEEL



3 miles down— and still going

HOW DEEP CAN WE GO FOR OIL? Certainly, only as deep as present-day casing will permit. As yet, we haven't reached our limit. The rigs are still holding up; the drill pipe, casing and tubing are taking their daily beatings and still doing their jobs.

But what is the limit? How much stress can be withstood?

One of the answers to this problem of stress, particularly to casing, is National Tube's *Deep-Well* Casing. *Deep-Well* Casing possesses exceptional physical characteristics. It is tough, strong and has good yield strength. Minimum yield strength is 110,000 psi at .6% total strain, and average ultimate strength is 139,000 psi. And perforating tests made on National *Deep-Well* Casing have been excellent. The next time you need high strength, high collapse resistance and maximum security in a casing, use National *Deep-Well* Casing. You can rely on it to do the best job possible.

Here are some of National Tube's most notable contributions to the oil industry:

National Deoxidized Bessemer Steel Casing and Tubing—Grades H-40, J-55. Especially well-suited for oil production because of its combination of high yield strength and good ductility.

National Warm-Worked Casing—Grade N-80. An extremely high-strength casing possessing a uniformity of physical properties which give it high collapse resistance and greatly increased joint strength. It is hydrostatically tested to 80% of minimum yield strength up to a maximum of 10,000 psi.

National Deep-Well Casing. The strongest casing produced under A.P.I. specifications, to meet constantly increasing depths. Due to the severe service for which it is intended, it is hydrostatically tested to 80% minimum yield strength up to a maximum of 12,000 psi.

National (B) *Buttress-Thread.* Developed to satisfy the need for a casing joint which will safely and economically support the weight of deep-well casing. The buttress-thread joint is comparable in strength to that of the body of the pipe itself.

• • •

For further information, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Ask for Bulletin No. 15.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

NATIONAL USS SEAMLESS

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Through research . . . a better way
A.O.Smith
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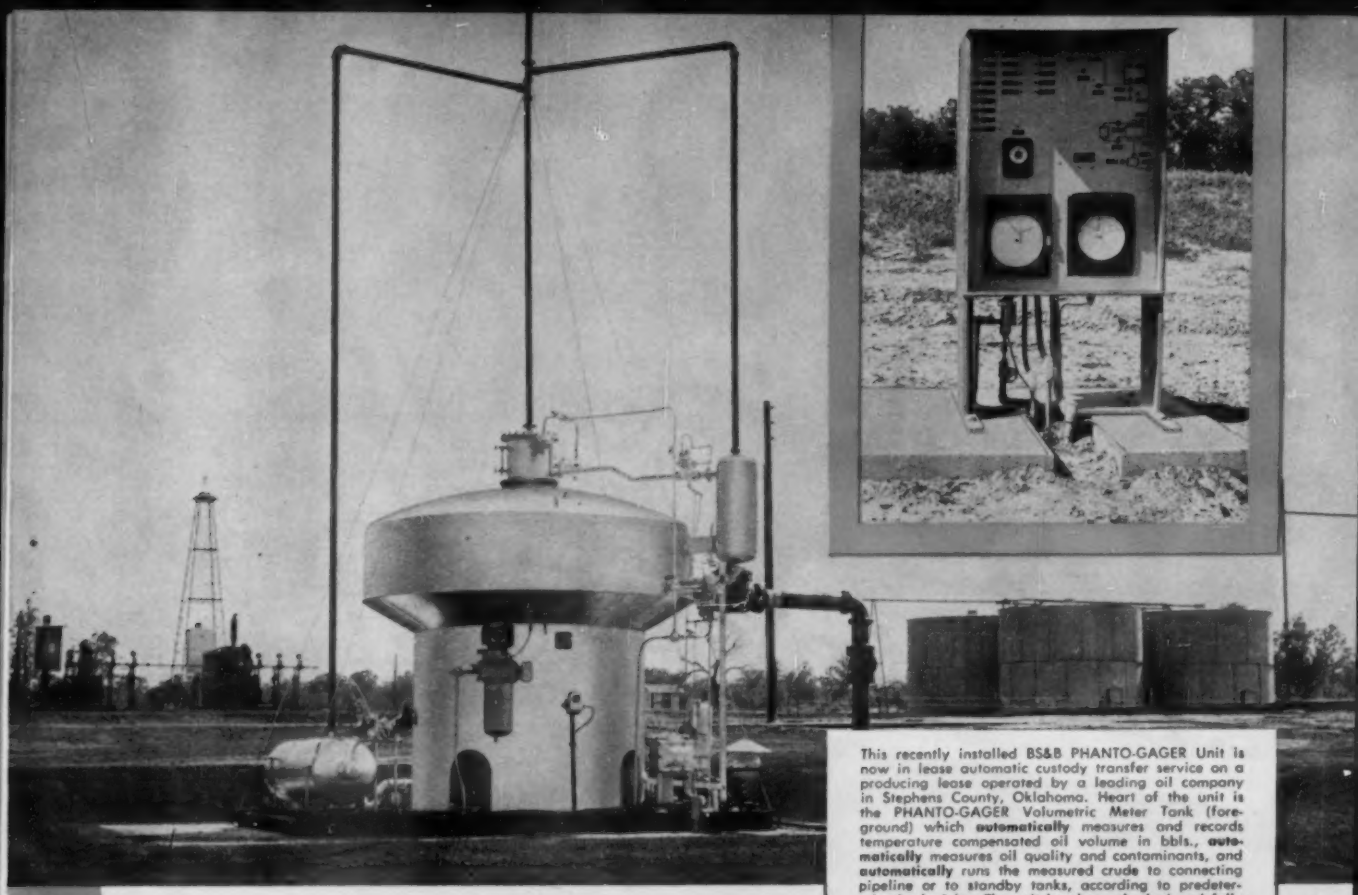

This recently installed BS&B PHANTO-GAGER Unit is now in lease automatic custody transfer service on a producing lease operated by a leading oil company in Stephens County, Oklahoma. Heart of the unit is the PHANTO-GAGER Volumetric Meter Tank (foreground) which **automatically** measures and records temperature compensated oil volume in bbls., **automatically** measures oil quality and contaminants, and **automatically** runs the measured crude to connecting pipeline or to standby tanks, according to predetermined schedules. The unit has been checked and fully approved by the pipeline company serving the area.

A Leading Oil Company Selects

BS&B *Phanto-Gager*

For Lease Automatic Custody Transfer

BS&B PHANTO-GAGER Units are offered for lease automatic custody transfer service in various sizes as skid-mounted assemblies, and with single or multiple metering and surge tanks. Fail-safe controls insure that no oil will be lost in case of power failure because:

1. The fill and empty valves on the meter tank are electrically interlocked.
2. Oil cannot be introduced into the meter tank after the measuring cycle has started, nor can oil be removed from the meter tank (other than to the pipeline) after the top gage has been made and before the run is completed.
3. All electrical controls, motors, instruments and wiring within 150 ft. of the meter and surge tanks are explosion proof.

The BS&B PHANTO-GAGER and the BS&B PHANTO-PUMPER, when used together, make up the complete BS&B PHANTO-MATIC Lease System which provides *full lease automation* from the wellhead to the pipeline. For full information, contact your nearby BS&B Man, or write to...

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Oilfield Equipment Division, Dept. 1-A11A

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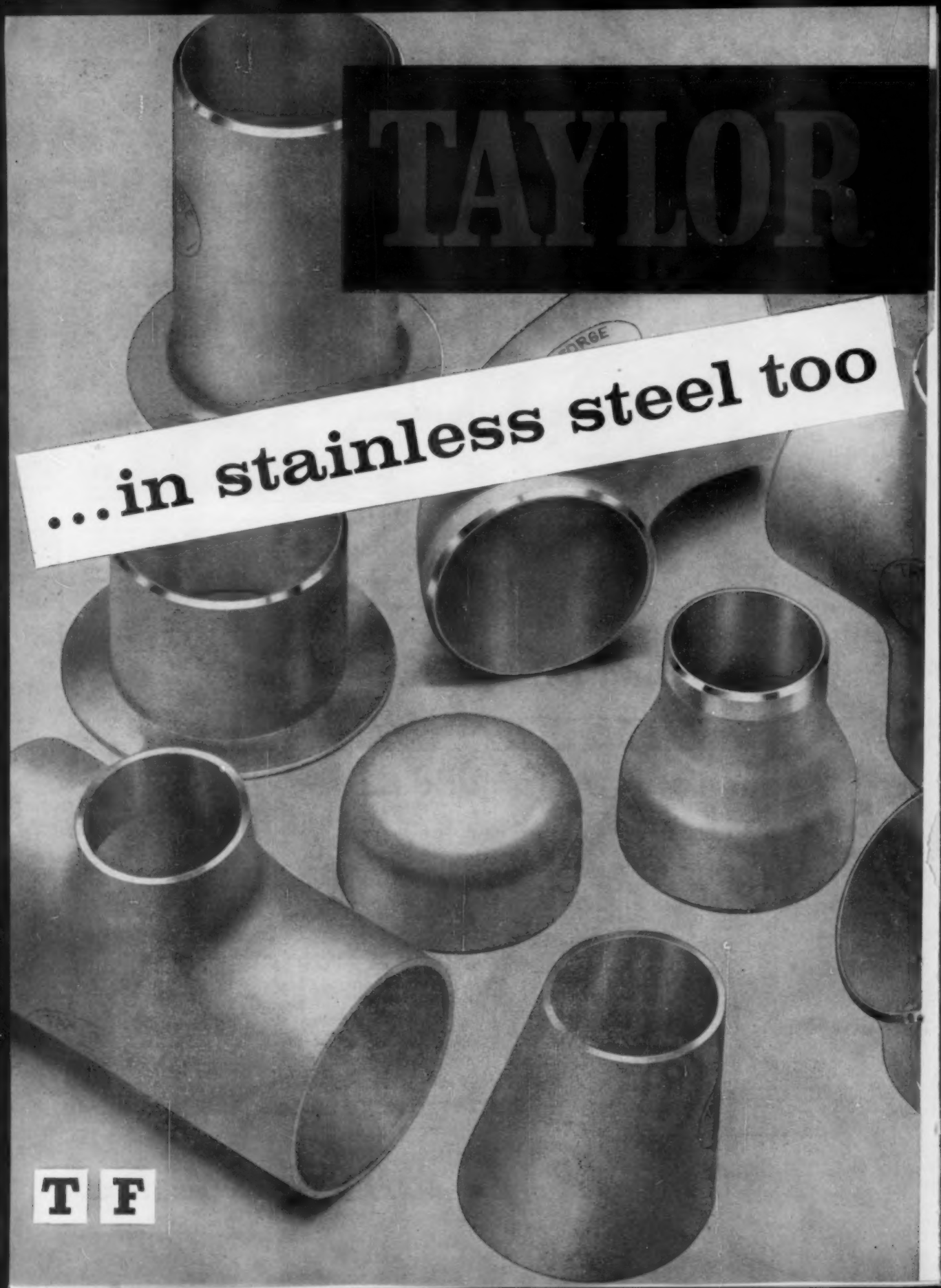
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...in stainless steel too
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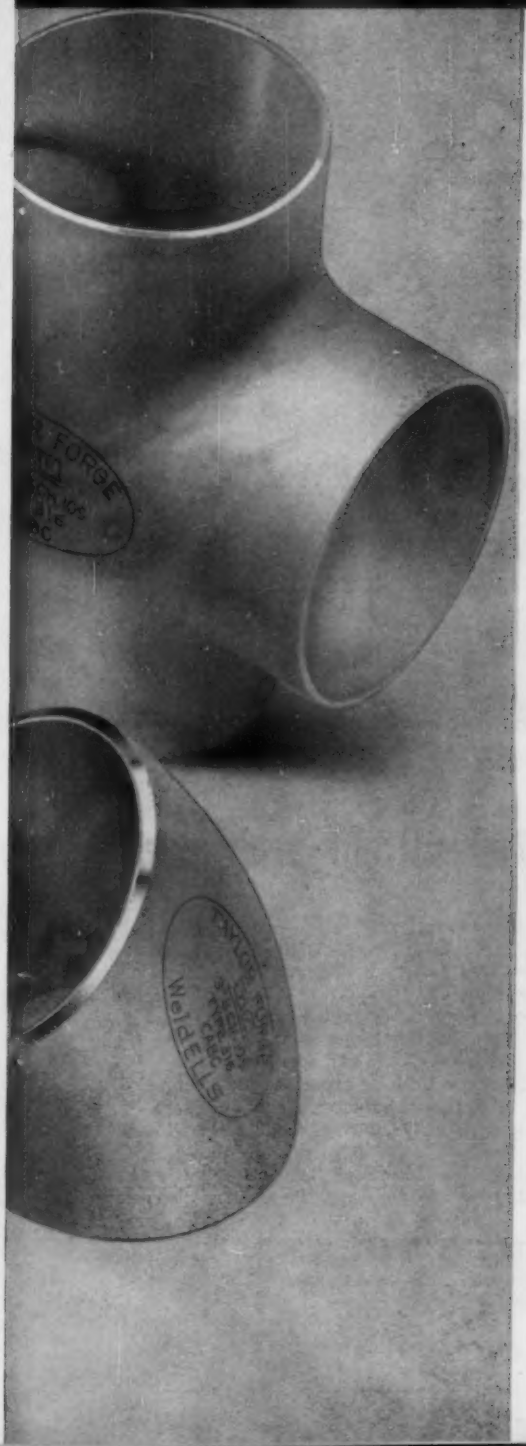
FORGE Welding Fittings and Forged Flanges



The complete line . . . the quality line . . . whatever you need . . . here it is . . .

* Schedules 5S—10S—40S—80S as well as all sizes and thicknesses covered by Standards in carbon steel.

* Seamless* WeldELLS—Tees—Reducers—Lap Joint Stub Ends—Caps—Crosses—Flanges—regularly furnished in stainless steel types 304—304L—347—316—316L. Details regarding other types of stainless and corrosion resistant alloys gladly supplied upon request.

*NOTE: Schedules 5S and 10S 90° and 45° WeldELLS are furnished seamless in sizes through 6". Schedules 40S and 80S are furnished seamless in all sizes.

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Now . . . Electronically Tested Condenser Tubes from Bridgeport

In addition to regular ASTM specification tests, Bridgeport Condenser Tubes may now be checked by ultra-sensitive, electronic tube inspection equipment. These modern nondestructive testing devices check each tube to insure that it is free from flaws, cracks, seams and slivers—differences in cross-sectional dimensions and chemical composition.

This testing method is fast and accurate. It eliminates human errors. In operation, the tubes pass through a magnetic field at a uniform speed. Flaws in the tube, which interrupt the pattern of the field, are instantly sensed by an electronic detector which signals acceptance through an oscilloscope and by audio and visual signals.

Electronic testing is just one of many fabricating and testing procedures used by Bridgeport to maintain its high standards of quality and workmanship and to give you better, more economical tube performance. It's in keeping with the requirements that must be met in today's increasingly critical operations.

Make use of Bridgeport's long experience and thorough familiarity with the manufacturing of condenser and heat exchanger tubes. Call your nearest Bridgeport Sales Office on your Copper, Admiralty, Aluminum Bronze, Aluminum Brass, Cupro Nickel, Duplex or other tube requirements.

Bridgeport BRASS CO.

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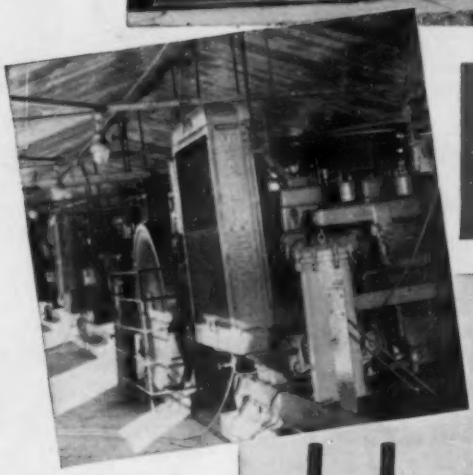
10 hp to 1235 hp



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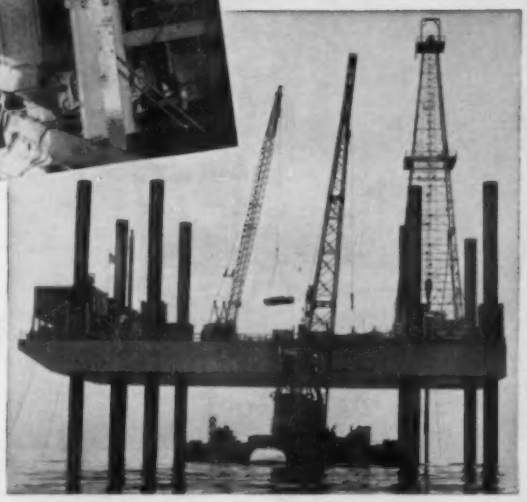

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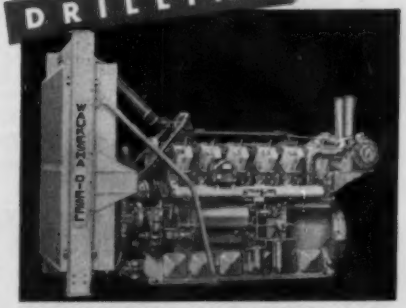
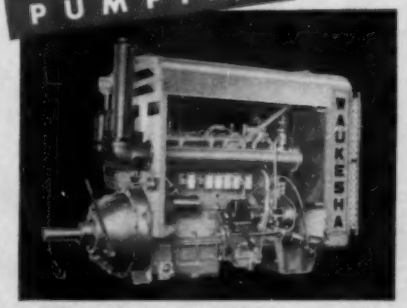
DRILLING



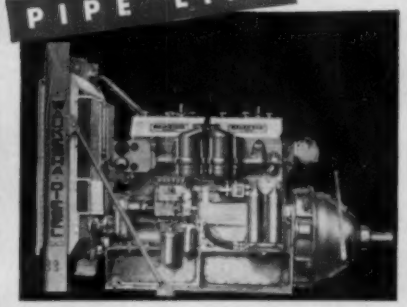
VLRDBSU Turbocharged Diesel Unit—twelve cyl., 8½-in. bore x 8½-in. stroke, 5788 cu. in. displacement, 1190 hp at 1200 rpm.

PUMPING



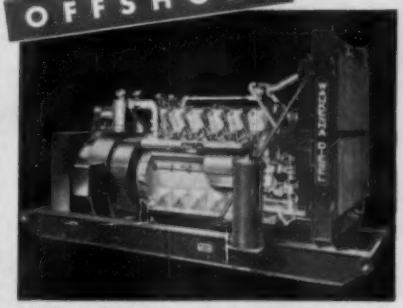
WAKU Special Long Life Unit—six cyl., 6¼-in. bore x 6½-in. stroke, 1197 cu. in., 125 continuous (65%) hp at 1200 rpm.

PIPE LINE



NKDBU Normal Diesel Power Unit—six cyl., 7-in. bore x 8¼-in. stroke, 1905 cu. in., 270 hp at 1200 rpm, (to 360 hp turbocharged).

OFFSHORE

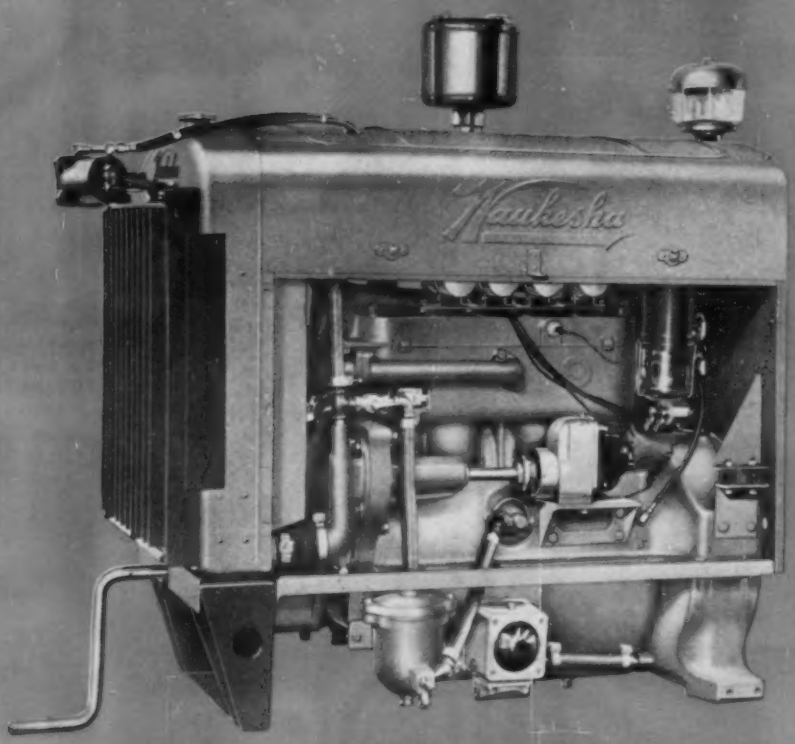


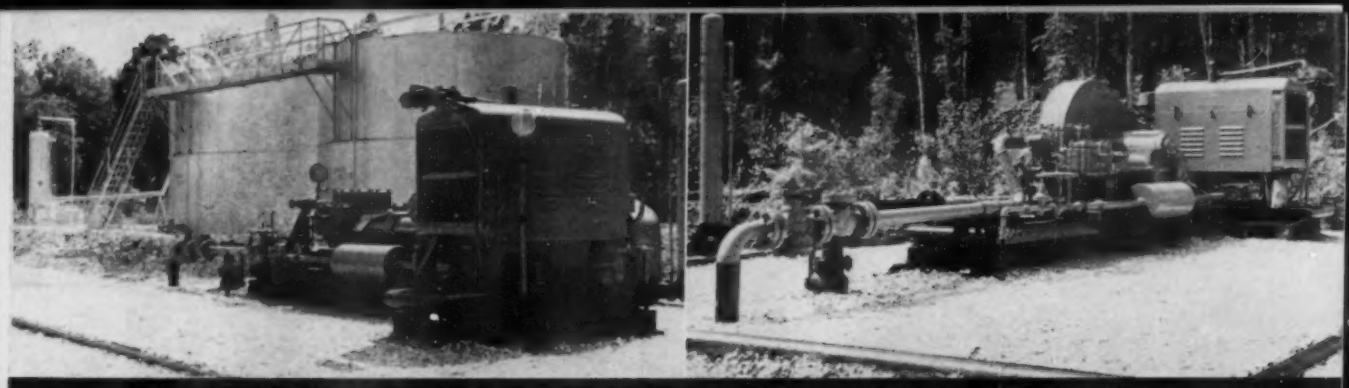
VLRD Series Diesel Enginator—twelve cyl., 8½-in. x 8½-in., 5788 cu. in. engine direct connected to heavy duty AC Alternator—up to 800 KW.

Now available from
Waukesha Sales and Service, Inc.

WAUKESHA
LONG LIFE
POWER UNITS

Oil field power –





Waukesha Long-Life Power Units are ideal for use in remote areas, unattended operations and wherever extra dependability is required.

--no routine maintenance

Here is an oil field power unit *you can count on for long periods of continuous duty — free from the worry and expense of routine maintenance.*

The **Long-Life** oil field Waukeshas are special gas power units — with such additional features as: specially-lubricated clutches, automatic oil levelizers, low tension magnetos with individual coil, low wear spark plugs, special fan belts, water stabilizing filters, water condensers and automatic radiator shutters.

All you need is an uninterrupted fuel supply and you can forget about inspections for long intervals. The Waukesha **Long-Life** unit permits considerable savings — in production pumping and compressor service for oil and gas feeder operation and similar uses. Write for Bulletin 1702.

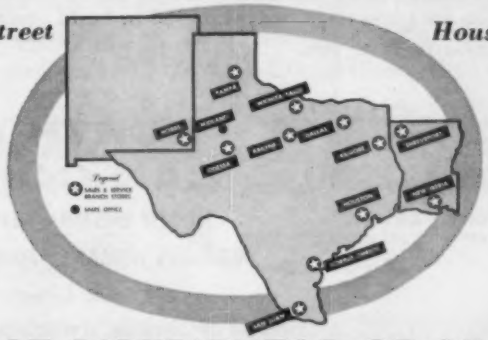
LONG-LIFE MAINTENANCE PLAN

For a nominal monthly service fee, Waukesha Sales & Service, Inc. will periodically inspect and service your Long-Life Power Unit — and keep it in tip-top shape. Ask your Waukesha Sales & Service, Inc. representative about this optional service.

Service is Our most important product

WAUKESHA SALES AND SERVICE, INC.

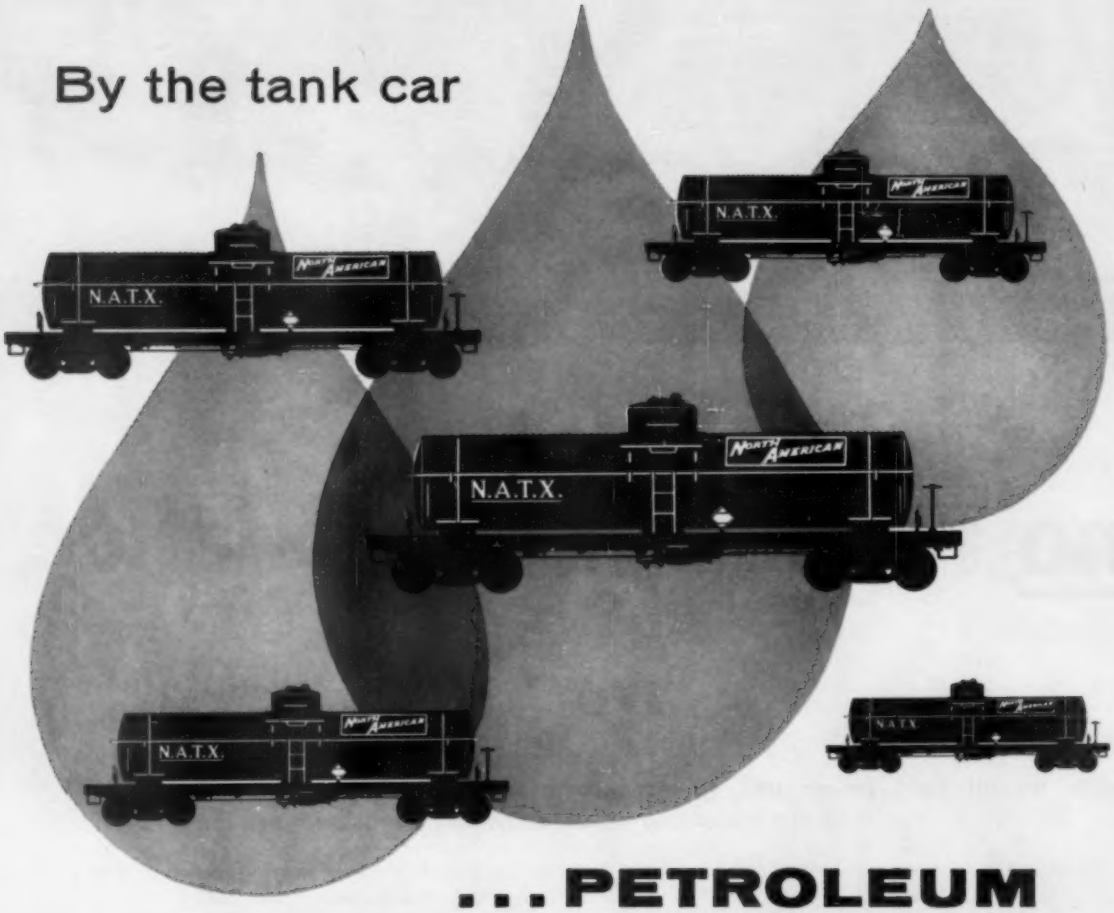
1422 Maury Street *Houston, Texas*



WORLD'S LARGEST DISTRIBUTOR OF OIL FIELD ENGINES

Waukesha Engines, Kohler Electric Plants, FloWay and Watermaster Pumps, American MARC Diesels, Marine Products Pumps, Stitt Spark Plugs, Cyclone Filter Elements, Wayne Air Compressors and Pumps, Weatherhead Hose and Fittings, Willard Batteries.

By the tank car



. . . PETROLEUM FOR YOUR CUSTOMERS

and plenty of goodwill for you!

Your North American tank cars are where you want 'em, when you want 'em . . . kept on the move by nine big repair and conditioning shops for dependable service. When you lease our equipment, you're assured of a continuous car supply for better planning, improved shipping, more satisfied customers. Your transportation needs are our business. If we haven't the cars you need, we'll be glad to build you special ones . . . and then lease them to you.

NORTH AMERICAN CAR CORPORATION

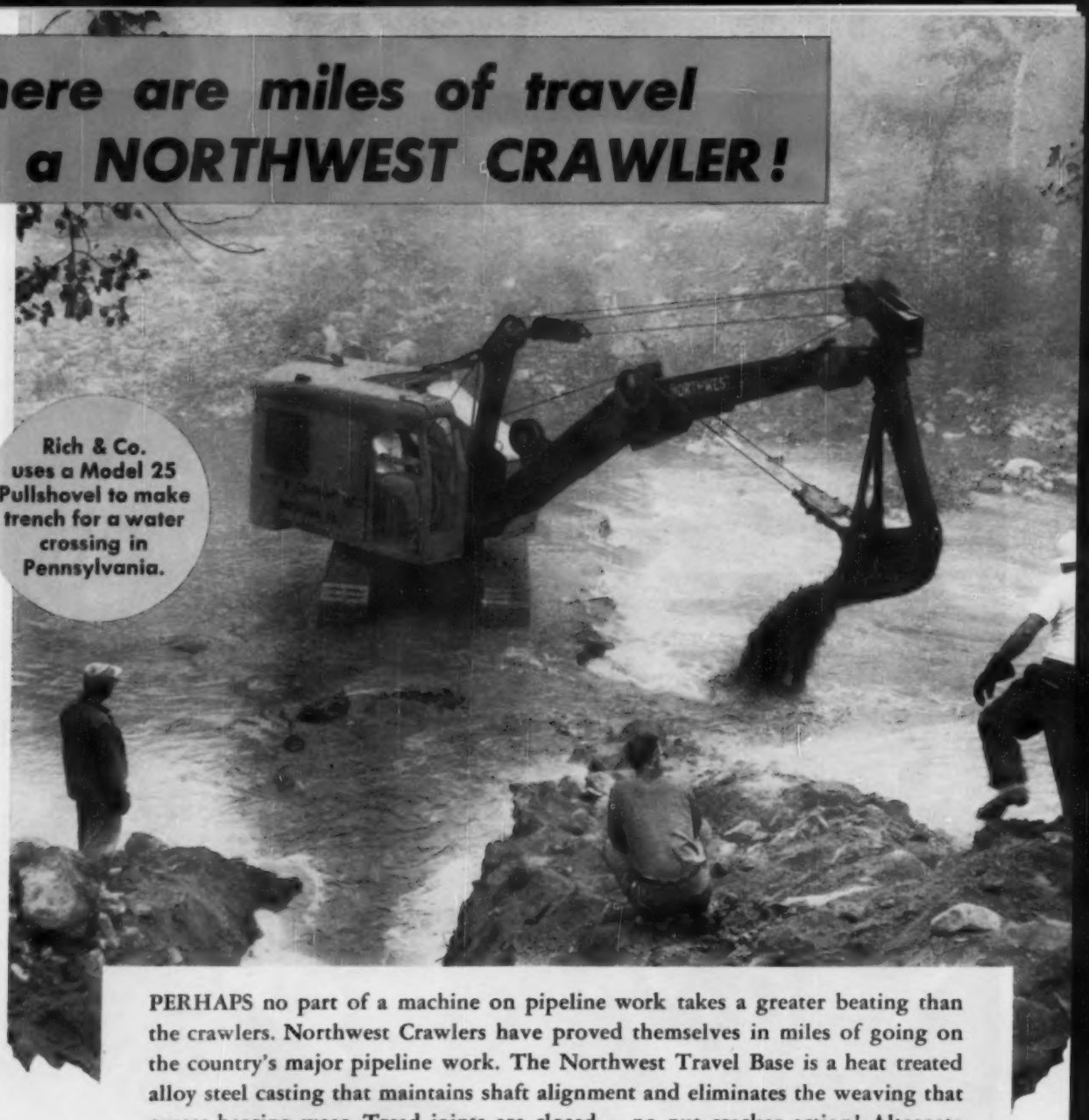
NORTH WESTERN REFRIGERATOR LINE COMPANY
MATHERS HUMANE STOCK TRANSPORTATION COMPANY

231 South LaSalle Street, Chicago 4, Illinois

A NATIONWIDE ORGANIZATION WITH BRANCH OFFICES IN IMPORTANT MARKET CENTERS

DALLAS • FOND DU LAC • ST. PAUL • ST. LOUIS • TULSA • SAN FRANCISCO • NEW YORK

There are miles of travel in a NORTHWEST CRAWLER!



Rich & Co. uses a Model 25 Pullshovel to make trench for a water crossing in Pennsylvania.

PERHAPS no part of a machine on pipeline work takes a greater beating than the crawlers. Northwest Crawlers have proved themselves in miles of going on the country's major pipeline work. The Northwest Travel Base is a heat treated alloy steel casting that maintains shaft alignment and eliminates the weaving that causes bearing wear. Tread joints are closed — no nut cracker action! Alternate lugs give a self-cleaning action and reduce the possibility of building up material between lugs. A ball and socket action between rollers and treads distributes bearing pressures evenly regardless of ground conditions. All travel gears are fully enclosed and run in oil and the final drive is through a heavy duty alloy steel chain.

It is simple, trouble-free — and *proved* in years of service. There are other advantages both in the crawler design and in the operating deck that you should ask about. Ask a Northwest Man and let him fill in the details.

THE GREATEST COMBINATION OF PROVED ADVANTAGES EVER BUILT INTO A SHOVEL, CRANE, DRAGLINE OR PULLSHOVEL

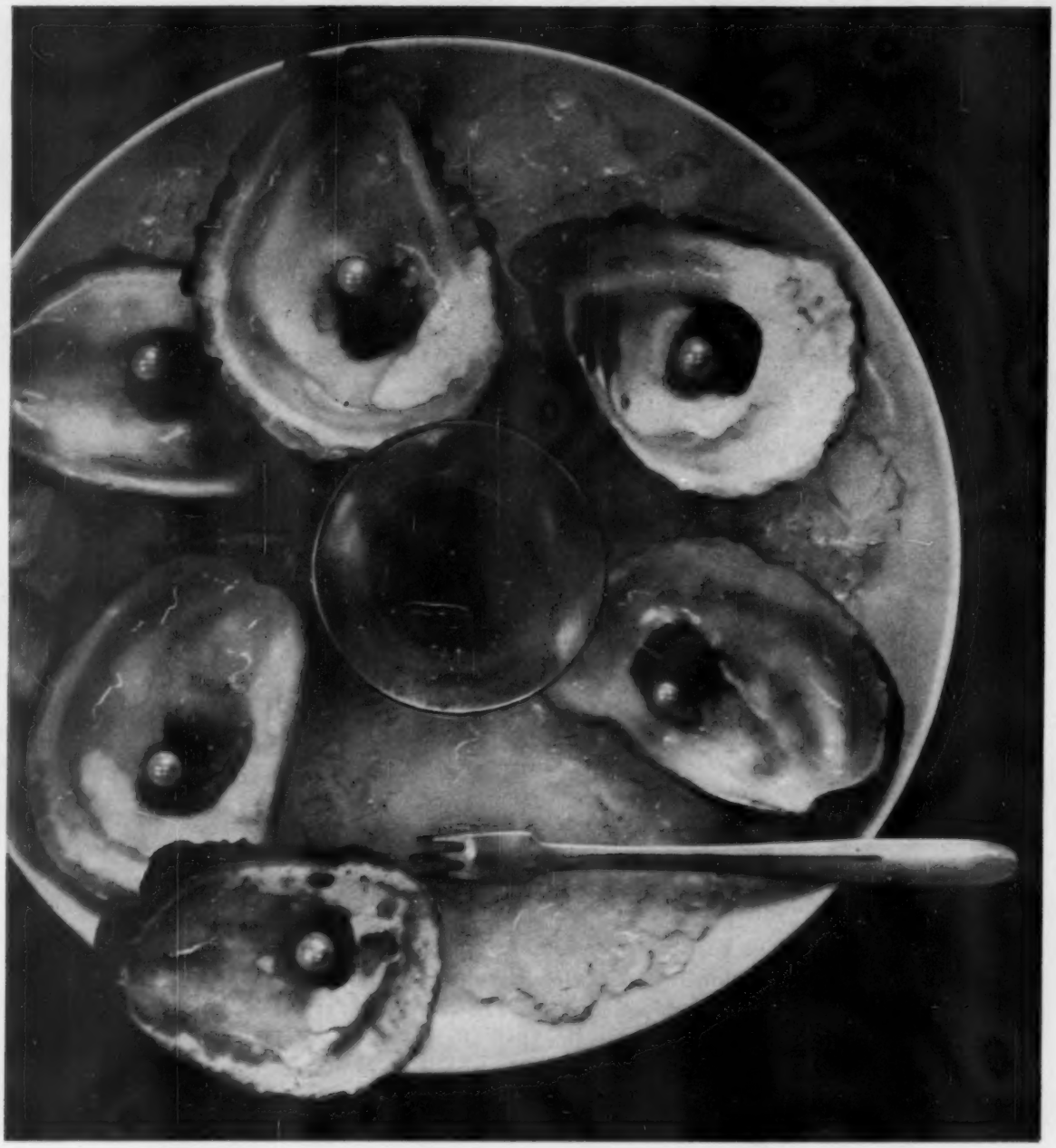
NORTHWEST ENGINEERING COMPANY

1517 Field Building • 135 South La Salle Street • Chicago 3, Illinois

NORTHWEST

SHOVELS • CRANES • DRAGLINES • PULLSHOVELS • TRUCK CRANES

S-25-13-LCG



CAUSTIC SODA: appetite at work

Your processing calls, at many steps, for the economical elimination of unwanted organic or inorganic compounds. You need, time after time, a chemical "appetite" more voracious, if more disciplined, than a Diamond Jim Brady's. To get it, you probably buy Columbia-Southern caustic soda.

You see, the appetite of our caustic *is* distinctively selective. Columbia-Southern *first* trained caustic's bite to the "oyster fork" refinement required for delicate rayon and cellophane production. And we *first* assured customers that caustic's appetite would be delivered fully whetted, through tankcar construction and unloading innovations now standard throughout the industry. We continue to supply *all* caustic consuming businesses, constantly adding to our diversified experience. It's this background that's reflected in our helpfully pertinent technical service.

So as your appetite for caustic soda grows, why not contract with the producer most in touch with your specific needs? Contact Columbia-Southern today for caustic that puts the bite on your *processing*, not on you.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION

SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY

ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte • Chicago • Cleveland • Boston • New York
St. Louis • Minneapolis • New Orleans • Dallas • Houston • Pittsburgh • Philadelphia
San Francisco

IN CANADA: Standard Chemical Limited and its Commercial Chemicals Division

Cast Steel Valves for the Petroleum Industry

are manufactured to meet and exceed the high performance requirements of critical applications. Lunkenheimer Cast Steel Valves provide longer service life and an extra margin of safety through outstanding design features, materials, and workmanship.

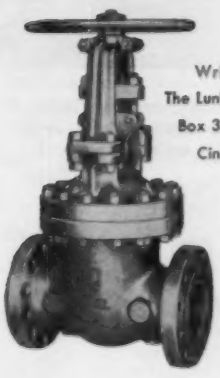
The cost of a Lunkenheimer Valve

gets smaller . . .

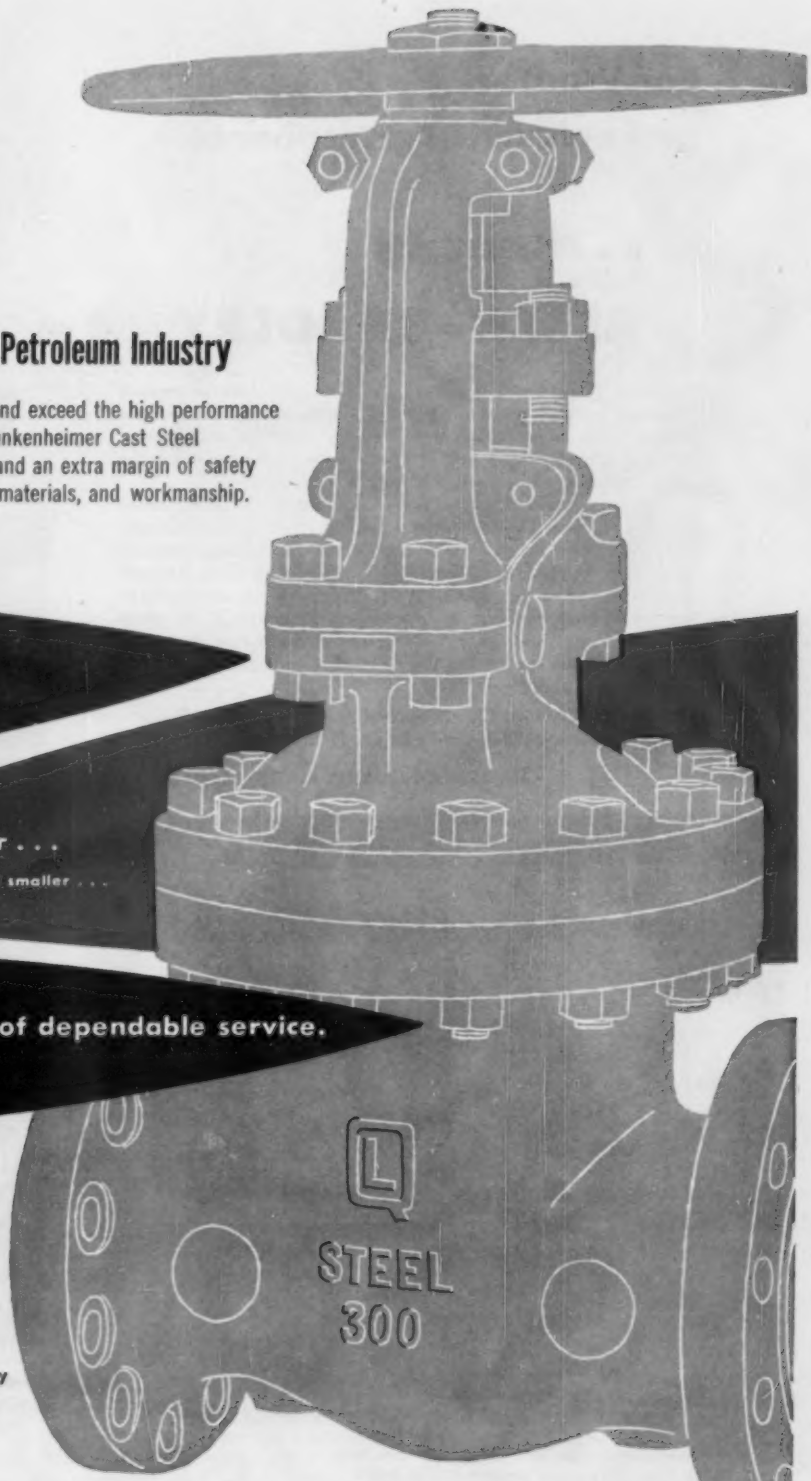
and smaller . . . and smaller . . .

with each passing year of dependable service.

A check on the cost of maintaining your cast steel valves will prove this point.



Write for Literature
The Lunkenheimer Company
Box 360, Annex Station
Cincinnati 14, Ohio



LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

For Weather . . .
or Explosive Atmospheres

. . . specify
ALLEN-BRADLEY

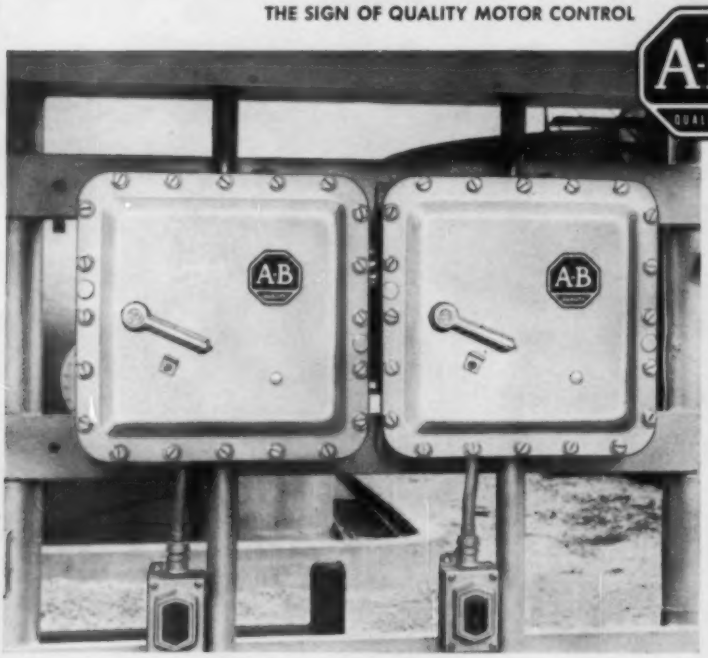
Regular "inspection" or maintenance becomes an important "expense" item when the nature of the installation requires a bolted cover, as used with watertight or explosion-proof enclosures. Valuable time is lost in opening the enclosure—and the same time is again lost when bolting down the cover.

You can save the major portion of this expense by using Allen-Bradley starters. Their solenoid design . . . with only *one* moving part . . . is good for millions of trouble free operations. Routine inspection is unnecessary. The double break, silver alloy contacts are *always* in perfect operating condition. The overload relays are unaffected by time or atmospheric conditions. In plain English . . . you can install A-B starters . . . and forget them.

Better specify "Allen-Bradley" for all of your control requirements—you cannot go wrong!

Allen-Bradley Co., 1304 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

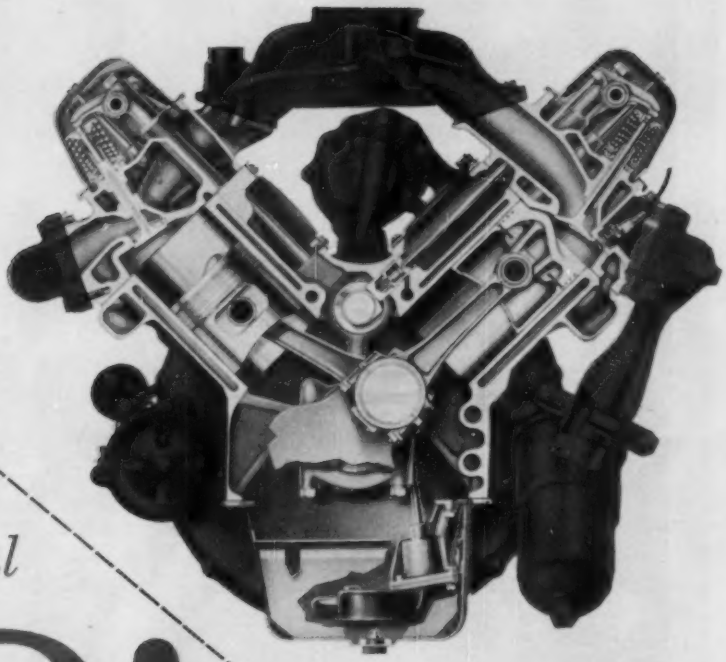
THE SIGN OF QUALITY MOTOR CONTROL



• Charging pumps for crude oil still in Ponca City, Oklahoma, equipped with Allen-Bradley motor controls with NEMA Type 7 explosion-proof enclosure.

• Pipeline gathering pump in Jenks, Oklahoma, with Allen-Bradley starter in a NEMA Type 3 weather-resistant enclosure.

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY



New International

V-8's

Built to stay on the job longer!

INTERNATIONAL heavy-duty V-8 engines stay on the job long after high stress modified engines have failed to satisfy.

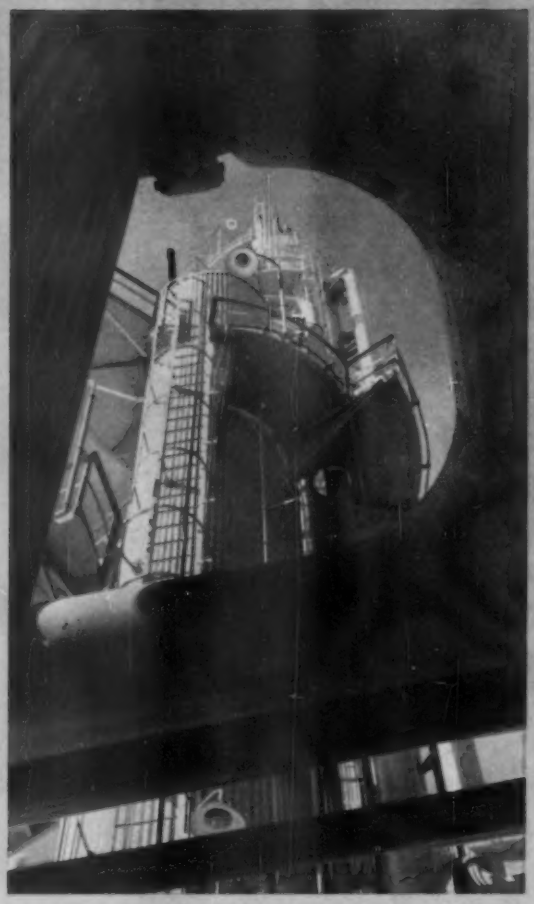
The big difference: INTERNATIONAL V-8's are *built* specifically for rugged, continuous truck operations—and they've proved it since introduction a year ago. Every part, from the heads to the pan, has built-in reserve life. For example: there are exclusive long-life "wet" replaceable exhaust valve guides, fully machined and high efficiency combustion chambers, Y-shaped, deep skirted, rigidly constructed special alloy cylinder block, and many other endurance features that also keep running costs low.

When you buy trucks to make a profit, your logical choice is an INTERNATIONAL, the heavy-duty favorite for the past 25 straight years because they are *built* to stay on the job longer.

They GO on the job! They *stay* on the job! V-8 powered INTERNATIONALS are available with 206, 226, 257 hp. engines—most powerful, most economical you can get. Models from 24,000 lbs. GVW to 76,800 lbs. GCW.

International Harvester Company, Chicago
Motor Trucks • Crawler Tractors
Construction Equipment • McCormick® Farm Equipment and Farmall® Tractors

International Trucks cost least to own!



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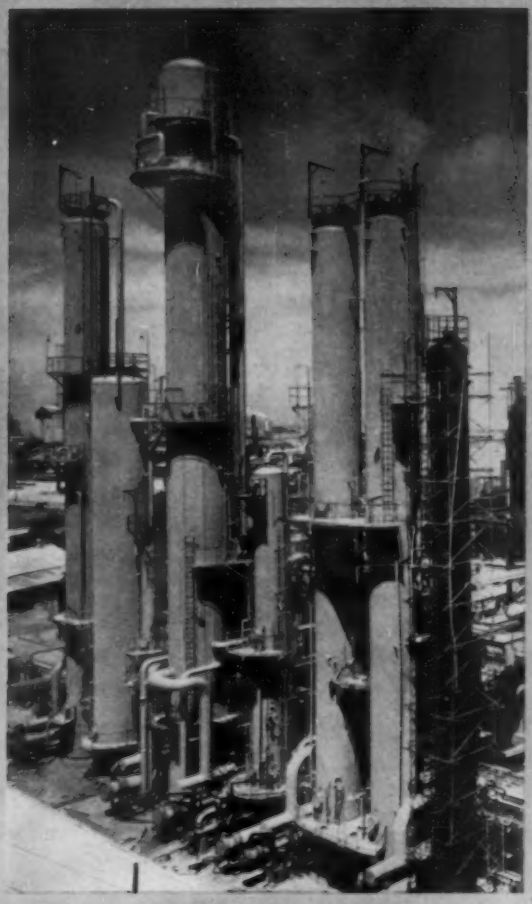
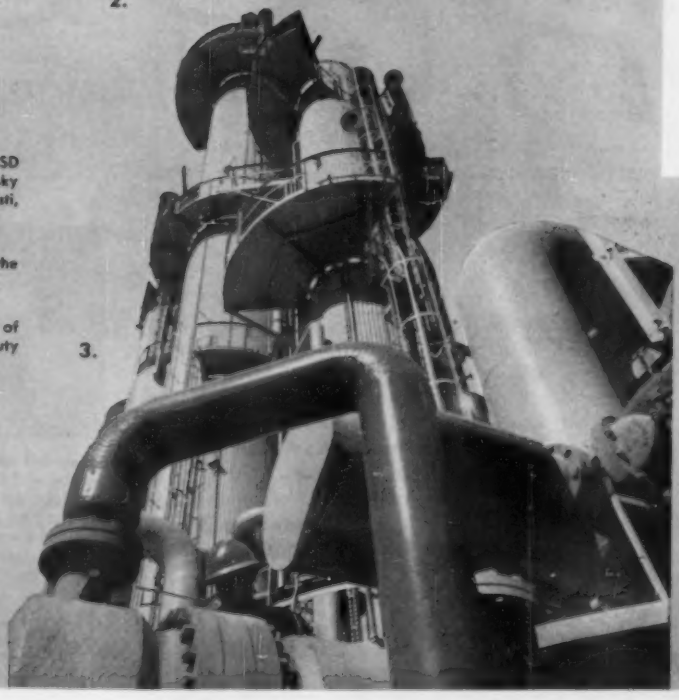


2.

1. The solvent extraction columns of the 5,000 B/SD Udex unit are dramatically framed against the sky at the Delhi-Taylor Oil Corporation's Corpus Christi, Texas, refinery.

2. Shown here is the Udex unit in operation at the Delhi-Taylor refinery, Corpus Christi, Texas.

3. Though highly functional the extraction towers of the 5,000 B/SD Udex unit add an element of beauty at the Delhi-Taylor refinery.



3.

Platforming—Udex Units Open New Petrochemical Market To Delhi-Taylor

By F. P. Sewell
Vice President
Delhi-Taylor Oil Corporation
Corpus Christi, Texas

F. P. Sewell

Customer confidence, plus our own confidence in the growth potential of petrochemicals prompted us recently to enter this field. Our investigation, some time before the spring of 1956, indicated a substantial market for benzene to be used in synthetic chemicals. We decided to build an installation for the production of aromatics. We needed a process that could smoothly fit into our operation, a process that could economically produce aromatics of highest purity. After carefully examining the available processes, we found that the Udex process efficiently and at low cost extracts benzene, toluene and xylenes simultaneously from a Platformate which we could produce in our existing Platforming unit. We were confident the Udex process was our answer.

The next step was a meeting with engineers of Universal Oil Products Company in the spring of 1956 to determine the design for the new Udex unit. With the design fitted to serve our requirements the only remaining problem was the time necessary to complete the unit. Accordingly, purchasing and preliminary expediting of the major components were left to UOP. This assured us of the fastest possible delivery of these items. We are indeed pleased that in just over a year, from design to on stream, we were able to keep our promise to our customers, supplying benzene exceeding nitration-grade specification. With successful aromatic production and a marketing program under way, we were also able to achieve our basic objective, "product diversification."

Increases Value of Products

A 5,000 B/SD Platformer, on stream since 1953, was designed originally with provisions to facilitate its change-over to the production of a Platformate best suited to aromatic extraction. Since 1953 this Platformer has been producing a Platformate used to up-grade the octane number of our pool gasoline. Thus, through converting our production to aromatics we were able to raise, substantially, the value of our products from this unit.

During the planning stages of the Udex unit with UOP we also launched into yet another phase of our expansion program. As a custom refiner we sell motor gasoline in quantity to several customers. We keenly feel a sense of responsibility to maintain the high octane level and quality of our pool gasoline consistent with the demands of today's high compression engines. To this end we made arrangements with UOP to install another Platformer, a 10,400 B/SD unit, and a 10,400 B/SD Unifining* unit. The Platformate produced in this unit, on stream in May, 1957, is used as a high octane blending component in our pool motor gasoline.

These units are also used to provide additional Udex feed stocks. This is done by charging a select feed to the Platformer-Unifiner in a blocked-out operation. The resulting Platformate is charged incrementally to the Udex unit. This Platformer is our third, and the second Platforming unit at the Corpus Christi refinery. The efficient operation and high quality of products from our first two Platformers influenced our decision to install this third Platformer.

Aromatic Production

Production of aromatics at the moment is approximately 2,000 B/SD. The growing benzene market includes application in the manufacture of phenol and styrene plastics, synthetic fibers, agricultural chemicals, detergents, pharmaceuticals and other chemicals. Toluene and xylenes are sold as chemical raw materials and solvents. Toluene finds some use also as a blending agent in aviation gasoline and as a "super-premium" gasoline blending stock.

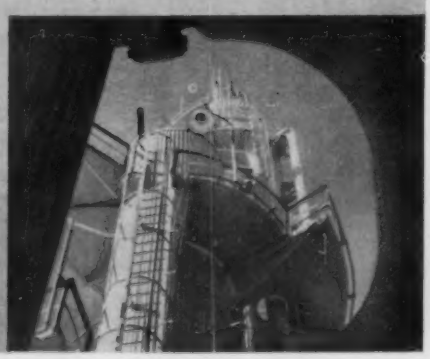
Production of benzene, toluene and xylenes from UOP Platforming® and Udex® units provides Delhi-Taylor profitable product diversification

designed, engineered and licensed by

UOP® UNIVERSAL OIL PRODUCTS COMPANY
30 ALGONQUIN ROAD, DES PLAINES, ILLINOIS, U.S.A.

More Than Forty Years Of Leadership In Petroleum Refining Technology

* Trademark of Universal Oil Products Company



WELL PROTECTION

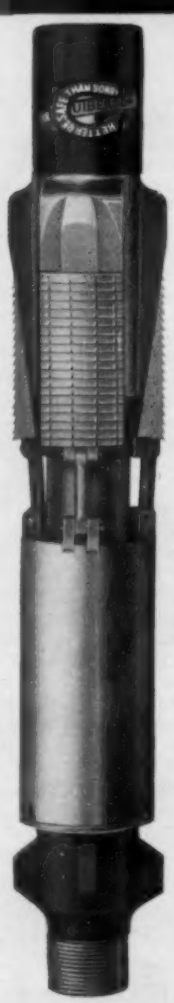
..and WELL WORTH IT!

GUIBERSON TUBING CATCHERS

Guiberson tubing catcher with anchor stops tubing motion — gives you full protection running in and out the hole. This combination saves wear on tubing, collars and threads — helps prevent leaks. It makes the pumping operation produce more fluid with less power.

Guiberson tubing catcher gives you low-cost insurance against accidents, lost time and production. It lets you forget the danger of cork-screwed or telescoped tubing. Should the string part or fall, the Guiberson tubing catcher automatically stops tubing with a drop of less than three inches.

Guiberson tubing catchers are made in all casing sizes and weights.



TYPE E
TUBING CATCHER

TYPE E
WITH ANCHOR

THE
GUIBERSON
CORPORATION

ESTABLISHED 1919
DALLAS, TEXAS
U. S. A.

Sold by
Oil Field Supply Stores
Everywhere

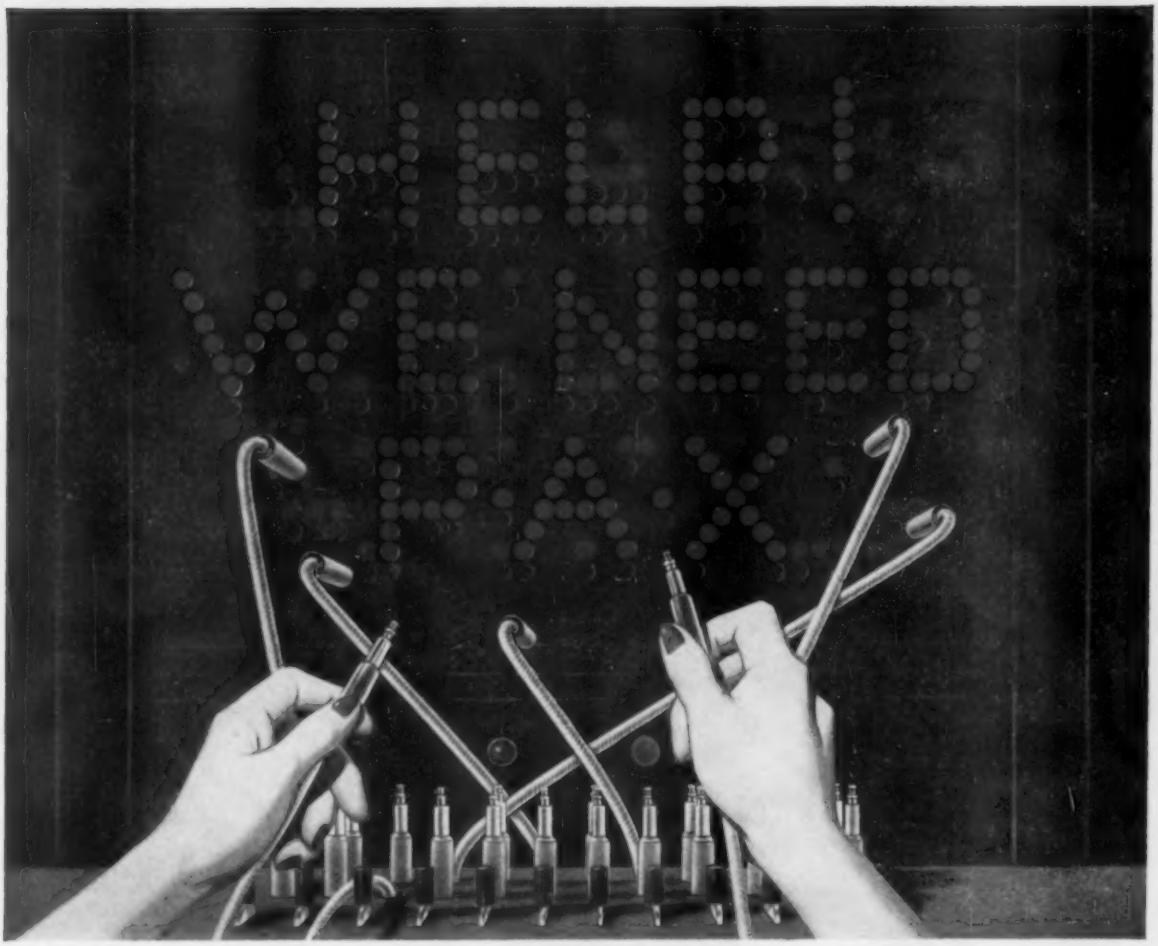
J&L pipe delivers dependable service

J&L tubular products pass the most critical gas industry test of all . . . service on the job. Long and dependable pipe life is assured through J&L's exacting quality control, extensive research and testing.

Specify J&L drill pipe, casing and tubing for gas well drilling and production, J&L line pipe for gas transmission and distribution. When you buy J&L tubular products you buy long, dependable service on the job. Buttweld, lapweld, seamless and Electric-weld are available in size ranges from ½" to 14" O.D.

Write today for complete information on the J&L line of tubular products. Jones & Laughlin Steel Corporation, Department 416, Three Gateway Center, Pittsburgh 30, Pennsylvania.

Jones & Laughlin
STEEL ... a great name in steel



A jammed switchboard is bad business . . .

How long can you afford to let a busy superintendent, a lease agent or an important customer wait until your phone lines are open? Needless to say, delays and busy signals can cost you *plenty*, in the fast-moving oil business.

What you need is a P-A-X business telephone system—the privately-owned dial telephone system that is entirely independent of your present switchboard. P-A-X handles calls within your organization, frees the rented switchboard to handle outside calls swiftly and efficiently. Customers reach you quickly, the first time they call. Your own employees save precious time, because P-A-X provides immediate, private contact between persons in all departments. And, P-A-X soon pays for itself. There are no toll, mileage, or rental charges. You *own* your system.

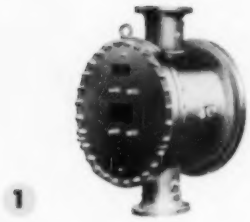
Write for a case history of how P-A-X and Automatic Electric engineering are saving important money for a major oil company. Automatic Electric Sales Corporation, Northlake, Illinois. FIllmore 5-7111.
In Canada: Automatic Electric Sales (Canada) Ltd., Toronto.
Offices in principal cities.

P-A-X telephone communications for the Petroleum Industry

AUTOMATIC ELECTRIC

A member of the General Telephone System
One of America's great communications systems

GENERAL TELEPHONE SYSTEM



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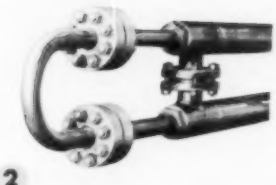

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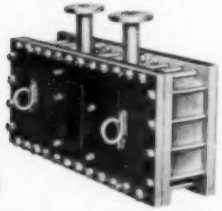

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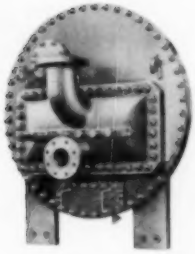

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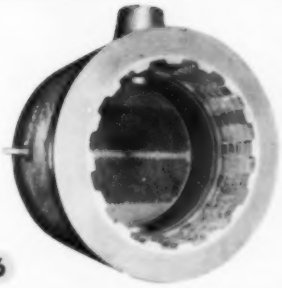

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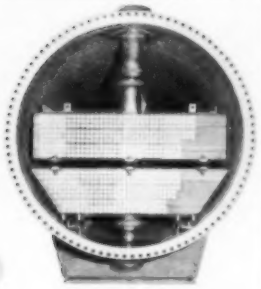

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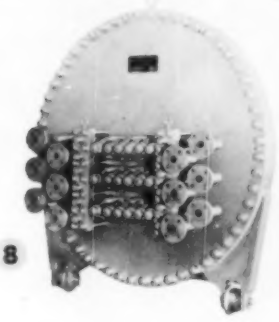


8

How many of these heads do you recognize

...they all belong to G-R heat transfer units

These are the heads of some of the many different types of heat transfer apparatus available from G-R. They indicate the wide range of G-R units . . . for condensing, cooling, heating or heat exchange . . . for any liquid, vapor or gas . . . for any capacity, pressure and temperature.

G-R designs and recommendations are backed by 90 years of G-R experience, the results of G-R continuous research and product improvement, and the performance records of many thousands of G-R installations throughout industry and all over the world.

Get the benefit of these assurances of authoritative advice and successful service for your particular heat transfer requirements. There's a helpful G-R representative near you. Write us about your needs and he will promptly get in touch with you.

1. Tubular Heat Exchanger, for a great variety of services in transferring heat from one fluid to another

2. Twin G-Fin Section, a unit with a wider range of heat transfer services than any other design on the market

3. Air and Gas Cooler, for cooling the air or hydrogen from generator windings and for other gas cooling or heating services

4. Atmospheric Open Section, with Bentube or K-Fin elements for cooling or condensing services

5. Type R Evaporator, for producing distilled boiler feed make-up at moderate pressures

6. Type L Feedwater Heater, for the highest pressures encountered in central power generating stations

7. Type J-2 Evaporator, for producing large quantities of boiler feed make-up at high pressure

8. Steam Generator, using waste heat to produce steam at boiler pressure

THE GRISCOM-RUSSELL CO.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

MASSILLON, OHIO

GR 388

"Can you furnish an efficient heat exchanger for 2 fluids of different transfer rates?"

"I need a stock design of heat exchanger for quick shipment."

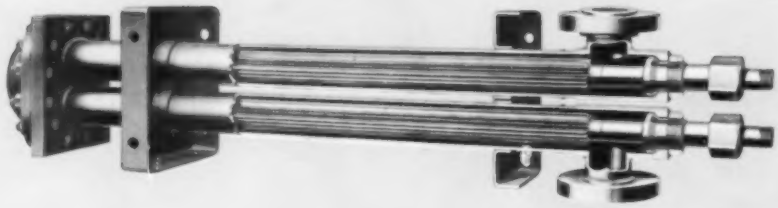
"Is it possible to get a heat exchanger with fins and tubes of different materials?"

"Do you have a standardized heat exchanger that can be used for a variety of services?"

"I want a heater system that will require least spare units."

FIVE QUESTIONS
One Answer...

THE G-R TWIN G-FIN SECTION



Yes, this "Universal Heat Exchanger" meets all these needs . . . and many more. It actually has the widest range of heating, cooling, condensing and heat exchange applications of any heat transfer apparatus on the market. • The G-R Twin G-Fin Section has proved its effective design and durable construction through 25 years of service. • This unit is the simplest type of heat exchanger, easy to install, economical to maintain, and with high salvage value because of its standardized design. Write for bulletin describing the many Twin G-Fin Section advantages in detail.

THE GRISCOM-RUSSELL CO.

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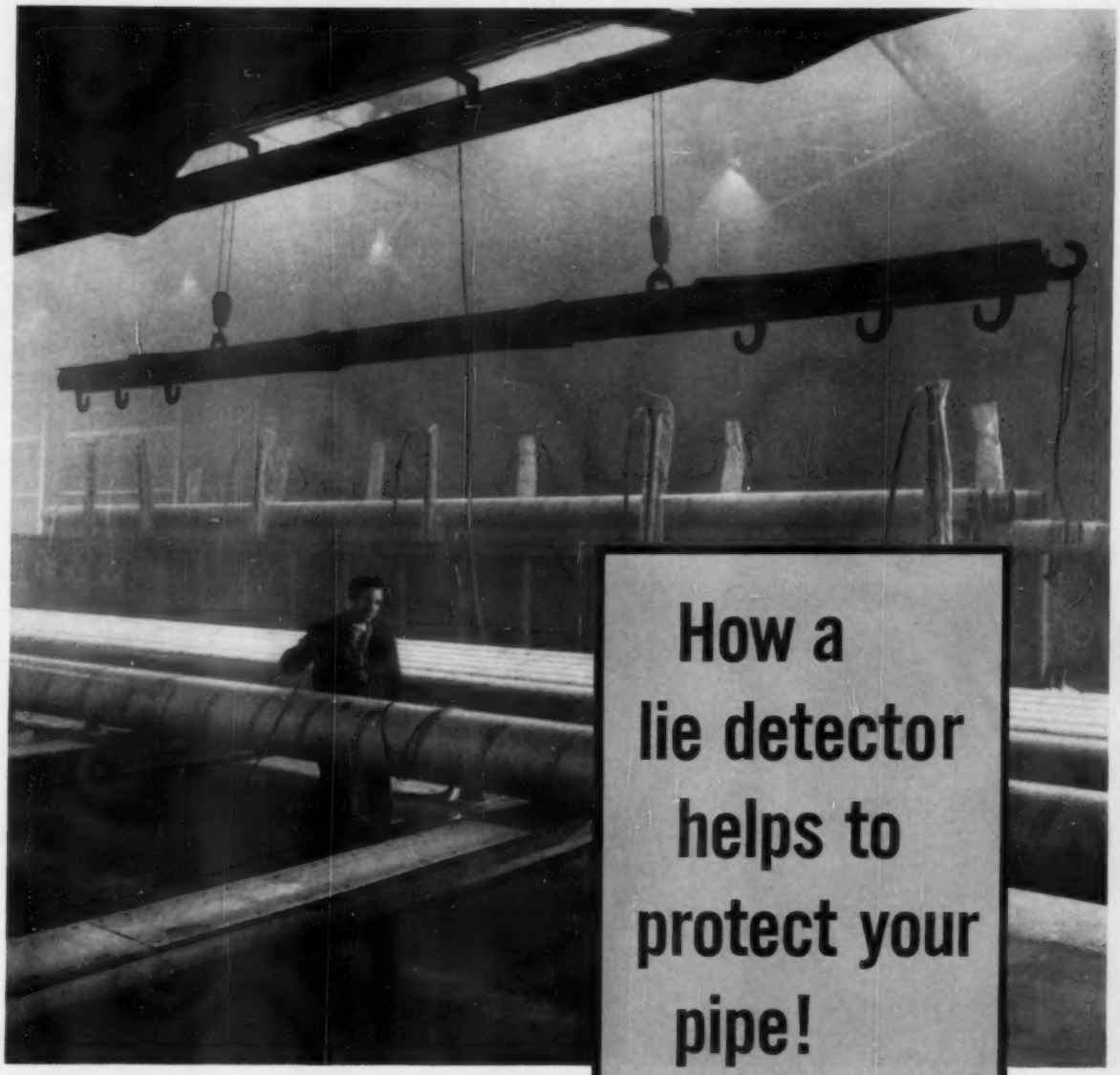
GR-374



How a lie detector helps to protect your pipe!

Here's one of the many ways we check our own work at Hill, Hubbell. This man is using an electronic "lie detector" on Hill, Hubbell wrapped pipe. Purpose: to find any possible imperfections in the coating which do not show through the outer wrap. Every square foot of pipe is so inspected before it leaves the plant. Pioneered by Hill, Hubbell know-how, the use of the electronic "lie detector" is another first by the first name in pipe protection.

Specify Hill, Hubbell wrapped pipe on your next job

FACTORY APPLICATORS OF COATINGS AND WRAPPINGS

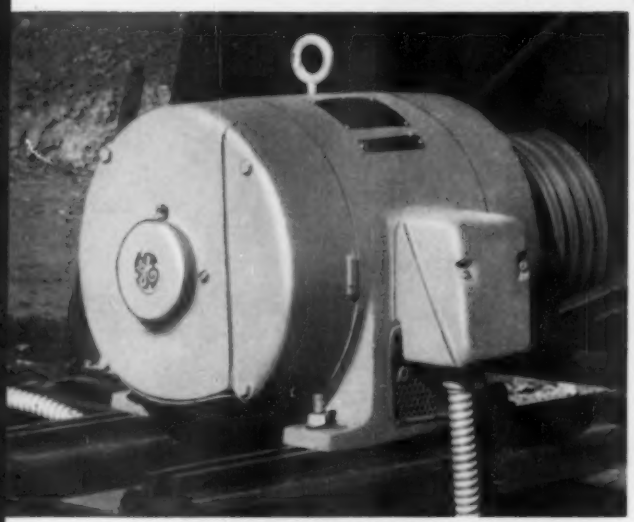
HILL·HUBBELL & COMPANY

DIVISION OF GENERAL PAINT CORP. • 3091 MAYFIELD ROAD, CLEVELAND 18, OHIO

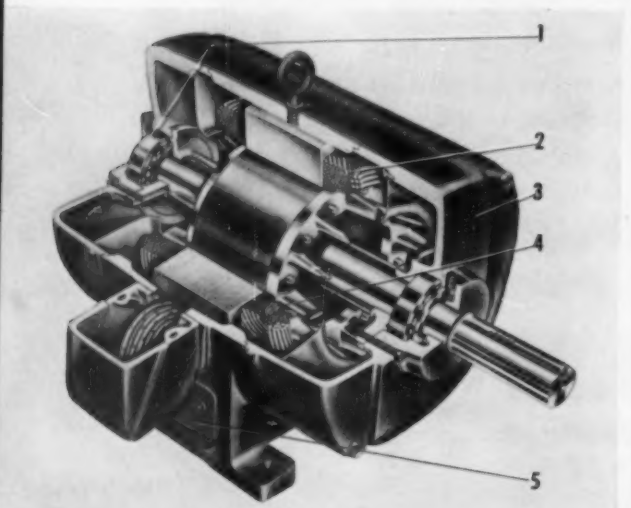
INSTALL IT... FORGET IT!

EASY-TO-MAINTAIN G-E TRI 55 CLAD MOTORS LAST LONGER

REG. U.S. PAT. OFF.



GREATER RIGIDITY AND STRENGTH of cast-iron frame and end shields prevent motor from being twisted out of line. Integrally cast ribbing on underside adds extra support.



General Electric's all-new Tri-Clad '55' oil field motor is specifically designed for long-life, easy-maintenance operation on your pumping applications. Protected against burnouts, dust and moisture, the new motor will run far longer without attention than ordinary motors.

Burnout protection for longer life—Burnouts are virtually eliminated with new Class 'B' insulation system utilizing Alkenex® heat-resistant wire enamel, and mica-glass laminate slot and phase insulation. This new system allows up to 40% higher temperature rise, yet extends motor life.

Advanced bearing system for easier maintenance—Under normal operating conditions, the advanced bearing system will operate longer without regreasing than any other motor bearing system. Effective seals on both sides of bearing housing keep grease in and dirt out, giving you all the service the long-lasting lubricant can deliver. Large grease reservoir *reduces maintenance to a few minutes every 5 years.* Pipe plugs on bearing housing permit regreasing even when motor is operating.

Greater physical protection for outdoor service—The new Tri-Clad '55' motor is built to take the weather. End shields and frame are rust-resistant cast iron. The insulation system virtually eliminates breakdown due to moisture. Air vents are protected, and removable screens guard against animal and rock damage.

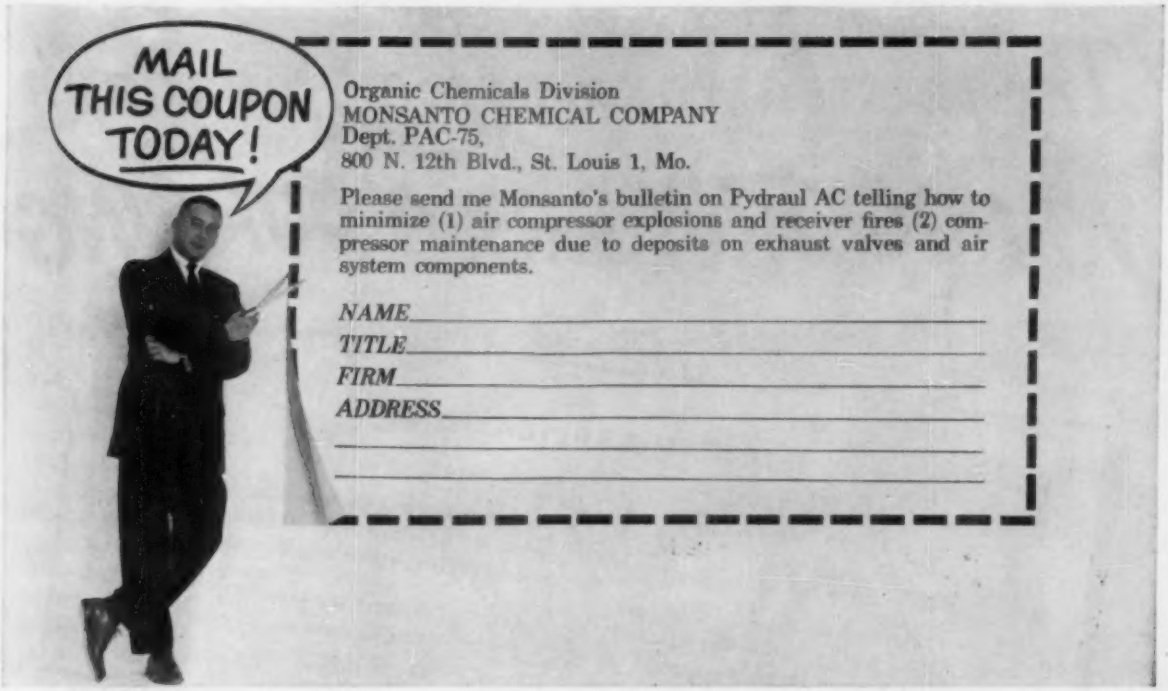
Complete information available locally—For full details on the easy-to-maintain, long-life Tri-Clad '55' oil field motor, contact your local G-E motor distributor or your nearby General Electric Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y. 899-1

CHECK THESE YEARS-AHEAD FEATURES

1. Advanced bearing system will last longer without regreasing than any other bearing system.
2. Water-shedding stator windings virtually eliminate breakdown due to moisture.
3. Rugged cast-iron frame helps prevent rust and accidental damage.
4. Class 'B' insulation system with revolutionary Alkenex® wire enamel allows up to 40% higher temperature rise . . . yet extends motor life.
5. Removable screens protect G-E oil field motors against damage from rodents and rocks.

Progress Is Our Most Important Product

GENERAL ELECTRIC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MONSANTO CHEMICAL COMPANY
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800 N. 12th Blvd., St. Louis 1, Mo.
Please send me Monsanto's bulletin on Pydraul AC telling how to minimize (1) air compressor explosions and receiver fires (2) compressor maintenance due to deposits on exhaust valves and air system components.
NAME
TITLE
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ADDRESS

Want to reduce fire hazard in your air compressors?...Read Monsanto's bulletin on Pydraul AC

When flammable oil mists and films gather in your compressed air system . . . you have a real fire risk!

Ease your mind—there's a new, fire-resistant lubricant to protect your equipment, your workers and your production flow from compressor fires and explosions caused by flammable oils. Simply replace your ordinary petroleum oils with fire-resistant Pydraul AC compressor lubricant.

Pydraul AC is chemically made, not a water-soap base mixture, not a petroleum oil. It's a completely new type of bearing-protecting lubricant. Pydraul AC is created especially for air compressors. With Pydraul AC lubrication you ease your mind about compressor fires and explosions. You may also reduce maintenance costs because Pydraul AC can minimize carbon deposits on air compressor exhaust valves and air piping systems.

There's no conversion problem—just drain out the flammable lubricant and replace with fire-resistant Pydraul AC—it's that easy!

For more facts—fast: Just mail the coupon today for the new Monsanto bulletin on Pydraul AC. No cost to you. It shows properties, field experience, operating economies, etc. Act *now.* Mail coupon *today!*

There's also a fire-resistant Pydraul for every industrial hydraulic job:

- General-purpose Pydraul F-9
- Pydraul 150 and Pydraul 60 for precision equipment
- Pydraul 600 for heavy equipment

PYDRAUL: Reg. U. S. Pat. Off.

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Taylor furnishes all required types of differential producing devices—including concentric, eccentric, segmental or quadrant orifice plates.

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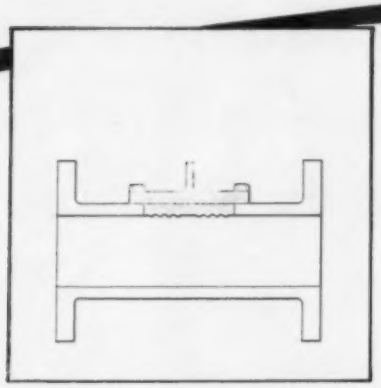
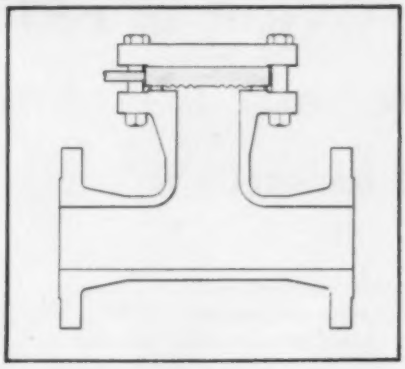




Type 95 flange (*left*), for use with chemical tee. For flow installations where diaphragm is flush with the inside of pipe, so that process fluid imparts a scouring action. Also for liquid level requiring flush installation. Maximum pressure 300 psi.

Wafer type sensing element (*right*), for use with standard 3″ ASA flange, where diaphragm need not be flush mounted, e.g., corrosive flow or liquid level measurement. Standard diaphragm material, for both types, 316 Stainless Steel; alternates available. Maximum pressure 1500 psi.

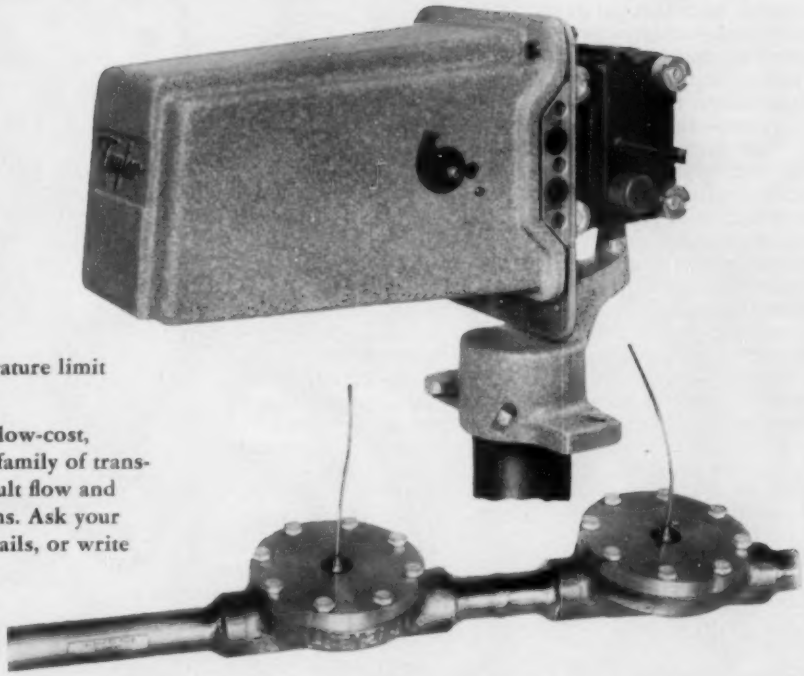
Taylor Instruments

Flow and Level measurement...

...NO PLUGGING... WITH THE NEW

205T VOLUMETRIC DIFFERENTIAL PRESSURE TRANSMITTER

Here at last is an economical way to eliminate purge and seal problems. The Taylor 205T Flow and Liquid Level Transmitter never has to be purged of deposited material and never suffers from corrosion, because it is completely isolated from the process material. The pressure-sensitive diaphragms may be installed flush with the inside of the pipe or tank in a variety of mountings. The temperature limit is 300°F. at the diaphragms.



Accurate, sturdy, dependable and low-cost, this latest addition to the Taylor family of transmitters can solve your most difficult flow and liquid level measurement problems. Ask your Taylor Field Engineer for full details, or write for **Bulletin 98281.**
Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

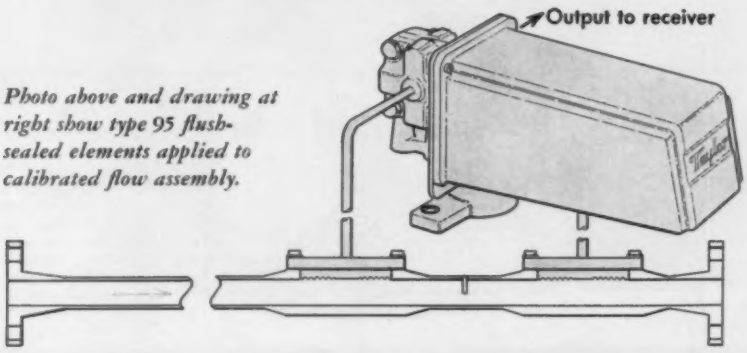


Photo above and drawing at right show type 95 flush-sealed elements applied to calibrated flow assembly.

VISION • INGENUITY • DEPENDABILITY

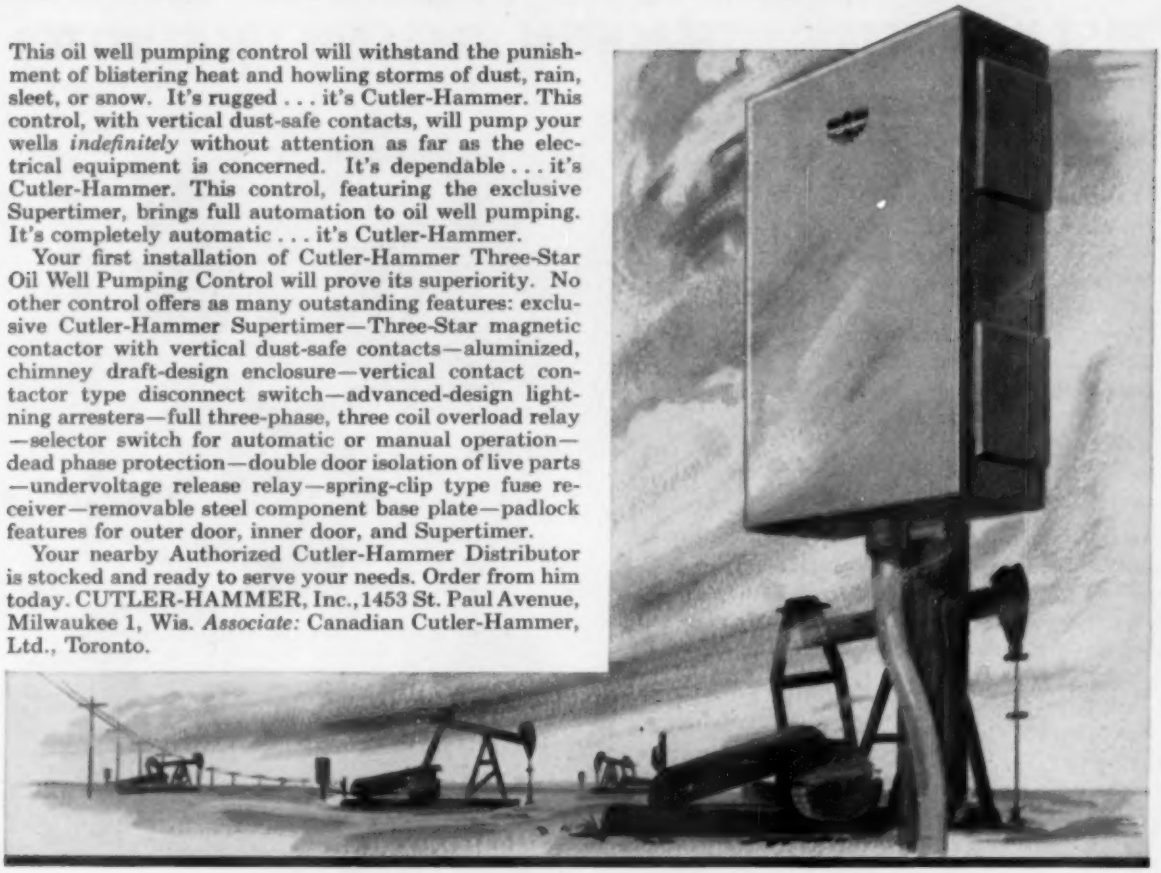
MEAN ACCURACY FIRST

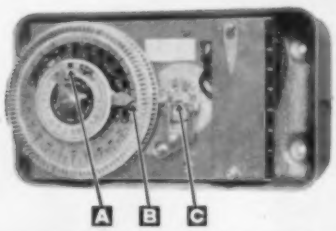
RUGGED. . . DEPENDABLE. . . COMPLETELY AUTOMATIC. . .

This oil well pumping control will withstand the punishment of blistering heat and howling storms of dust, rain, sleet, or snow. It's rugged . . . it's Cutler-Hammer. This control, with vertical dust-safe contacts, will pump your wells *indefinitely* without attention as far as the electrical equipment is concerned. It's dependable . . . it's Cutler-Hammer. This control, featuring the exclusive Supertimer, brings full automation to oil well pumping. It's completely automatic . . . it's Cutler-Hammer.

Your first installation of Cutler-Hammer Three-Star Oil Well Pumping Control will prove its superiority. No other control offers as many outstanding features: exclusive Cutler-Hammer Supertimer—Three-Star magnetic contactor with vertical dust-safe contacts—aluminized, chimney draft-design enclosure—vertical contact contactor type disconnect switch—advanced-design lightning arresters—full three-phase, three coil overload relay—selector switch for automatic or manual operation—dead phase protection—double door isolation of live parts—undervoltage release relay—spring-clip type fuse receiver—removable steel component base plate—padlock features for outer door, inner door, and Supertimer.

Your nearby Authorized Cutler-Hammer Distributor is stocked and ready to serve your needs. Order from him today. CUTLER-HAMMER, Inc., 1453 St. Paul Avenue, Milwaukee 1, Wis. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto.





NEW CUTLER-HAMMER Supertimer

This is automation in action. You pre-set the Supertimer to meet your field allowable and the control will do the rest, automatically. It starts, stops, restarts and cycles indefinitely, precisely according to your schedule. If a power outage occurs, any number of C-H controlled pumps are automatically restarted in an exact sequence to avoid overloading the power lines on inrush. Unfortunate coincidental starting of even two pumps is impossible.

- **A** Sets the precise restarting time delay from zero to 180 seconds. This is exclusive with the Supertimer—unfortunate coincidental starts of even two pumps are impossible.
- **B** Sets the daily pumping schedule—pull a tab for each fifteen minutes of pumping, space them through the daily 24 hour period as desired.
- **C** Sets the weekly pumping schedule—1, 2, 3, 4, 5, 6 or 7 days per week as desired.

Member American Petroleum Institute

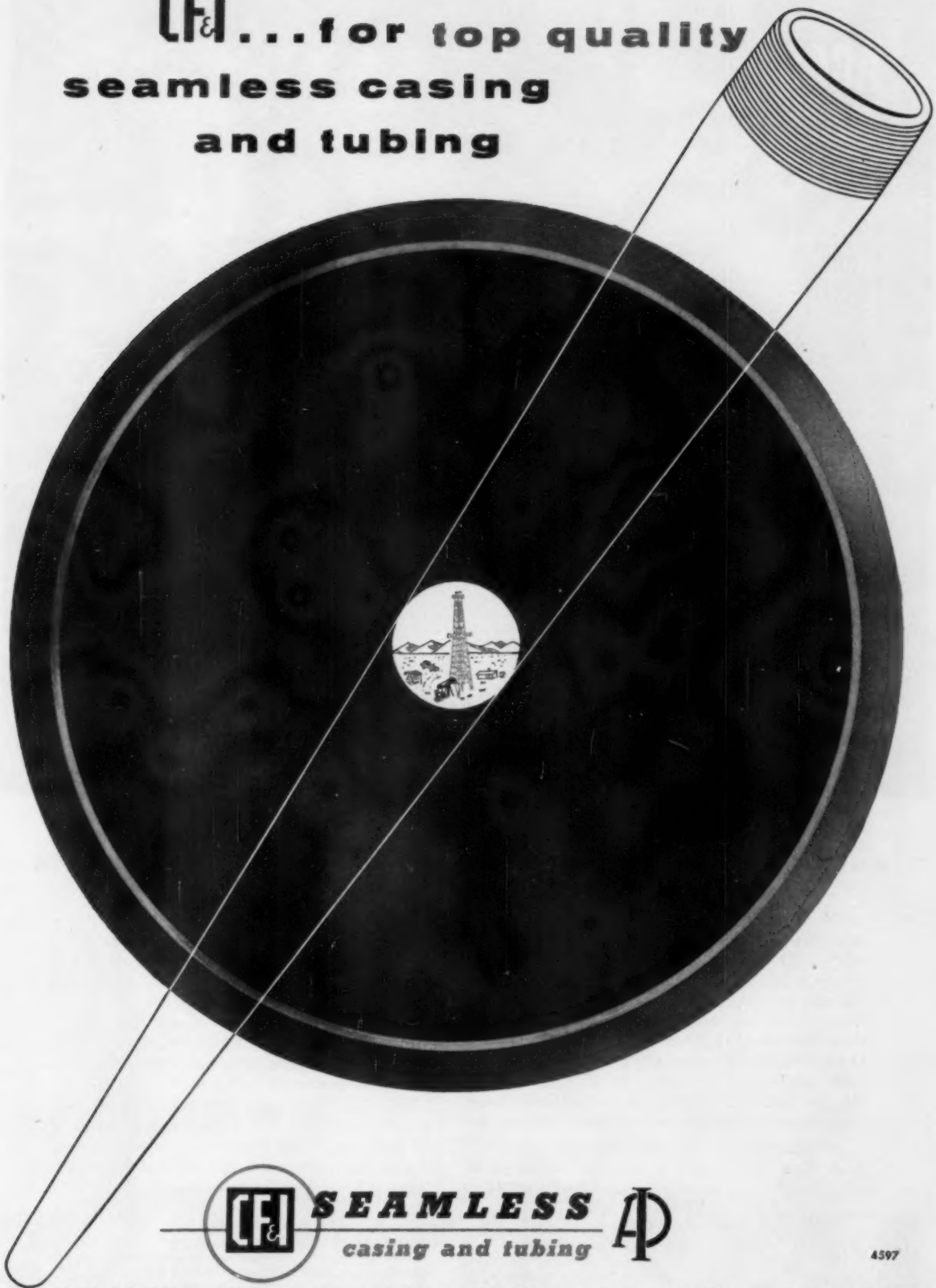
CUTLER-HAMMER ★ ★ ★ MOTOR CONTROL C-H

COMPLETE PROTECTION. The control is protected against lightning with exclusive, advanced-designed lightning arresters; and the three coil overload relay protects the pump motor from overloading and dangerous single phasing which often results from lightning.

CHIMNEY DRAFT VENTILATION. The heat-reflecting, aluminized enclosure insures a constant circulation of air . . . no nuisance tripping because of trapped heat.

DUST-SAFE CONTACTS. Dust-Safe vertical contacts stay clean and eliminate the necessity of contact replacement.

CF&I . . . for top quality seamless casing and tubing



CF&I SEAMLESS casing and tubing

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THE COLORADO FUEL AND IRON CORPORATION • DENVER, COLORADO

ACCO
for Better
Values

R-P&C VALVES

DESIGNED FOR DEPENDABILITY

BAR STOCK VALVES FOR CLOSE CONTROL, ESPECIALLY SUITED FOR CLOSE-COUPLED INSTALLATIONS

• rated for pressures up to 10,000 PSI •

• The bar stock valve, designed originally by R-P&C engineers, is really a versatile performer. First developed for instrument use, bar stock valves have proven to be the answer to valve problems of many different kinds. Designed for close control, they are ideal for throttling service. Their compactness makes them the natural choice for crowded locations such as panel boards. Economically priced, they serve in many applications as general purpose valves. And they are built in a wide variety of materials—can withstand extremely high temperatures and pressures.

For example, the **Fig. 1040-A Valve** shown here, made from carbon steel, is rated for 10,000 psi at 150°F. Each of these valves is individually tested at 15,000 psi before it leaves the factory.

R-P&C's complete line of bar stock valves includes constructions in 12-14 chromium stainless steel, 18-8 molybdenum stainless steel and bronze. Sizes range from ⅛" to 1" in globe and angle styles with female ends, male and female ends, or male union ends. For extremely severe throttling services, R-P&C bar stocks can be supplied with stellite discs for extra abrasion resistance.

Your R-P&C distributor carries not only a complete line of bar stock valves but also a wide selection of gate, globe, angle and check valves in bronze, iron, and cast and forged steel. You will find the answer to your valve problem in his selection.

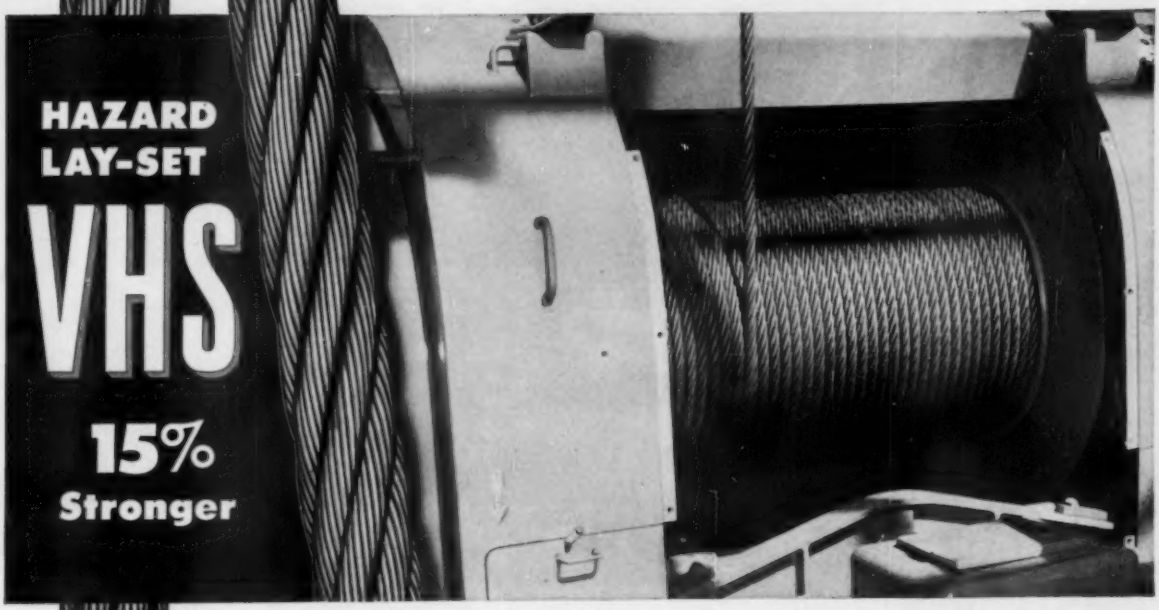
FREE WALL CHART
"How to Protect Your Valves"
Installation pointers, operating tips, clues to longer valve life. They are all on this 22" x 17" wall chart. Write for your free copy.

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

ACCO

New LAY-SET VHS+
Tailor-made Cut-off Practices =Longer Drilling Line Life



• Cost-conscious drilling operators are finding that they can get longer life from their rotary drilling lines if they will follow two simple steps: first, install a line of new, tougher, stronger LAY-SET **VHS**. Next, follow religiously a tailor-made cut-off program, developed especially for their particular drilling operation by their Hazard field representative.

Higher Safety Factor

New LAY-SET VHS (Very High Strength) is at least 15% stronger than Improved Plow Steel, the strongest grade formerly available. This means a factor of safety about 15% higher than with IPS lines. You get the same factor of safety with 10 lines of VHS that you would get with 12 lines of IPS.

Faster Drilling

This extra strength saves you time. With VHS you can drill deeper before increasing the number of parts of line...make round trips faster...and eliminate in many cases any necessity for buying new blocks or regrooving sheaves to use larger diameter lines for higher safety factor.

Resists Wear

New LAY-SET VHS is tougher, too. It has greater abrasion resistance and higher resistance to peening. This means that you will get extra ton miles...longer wear...if you follow the right cut-off practices.

Tailor-made Cut-off Practice

Good cut-off practice varies from rig to rig and from drilling site to drilling site. Your Hazard field representative has the wide experience necessary to establish the best cut-off practices for your particular drilling operation.

For extra ton miles, get the expert services of your Hazard field representative. Your local Hazard distributor store personnel will be happy to arrange his early visit. Call them today.

For further information on LAY-SET VHS drilling lines, write to the nearest Hazard office for Brochure DH-522

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American Chain & Cable Company, Inc.

Sales Offices in: Wilkes-Barre, Pa., Atlanta, Chicago, Denver, Houston, Los Angeles, New York, Odessa, Tex., Philadelphia, Pittsburgh, Portland, Ore., San Francisco, Bridgeport, Conn.

PLANTS IN WILKES-BARRE, PA., AND HOUSTON, TEXAS

the LUFKIN formula

FOR SELECTING THE RIGHT PUMPING UNIT FOR YOUR WELL . . .

$$S_p = 35E + \sqrt{F^2 + M^2} + Q + P_e + f^{max}$$

E – EXPERIENCE, YEARS.

F – MODERN MANUFACTURING FACILITIES

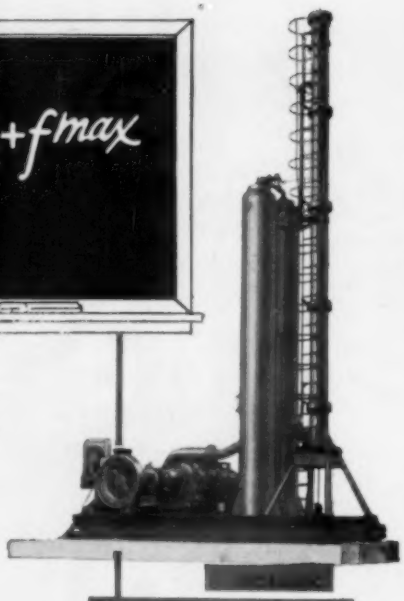
M – UP TO DATE METHODS

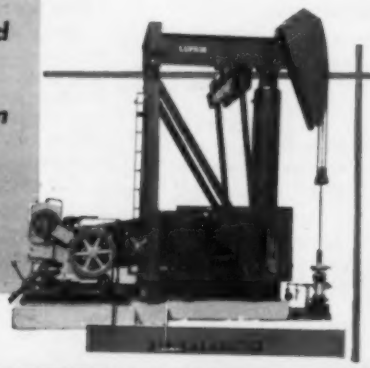
Q – BEST QUALITY MATERIALS

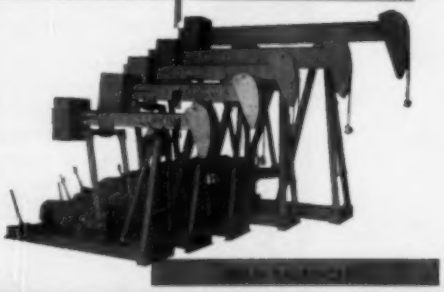
P_e – SOUND ENGINEERING PRACTICE

f^{max} – LARGE SAFETY FACTORS.

S_p – *SUPERIOR PUMPING UNITS*







There's always a standard LUFKIN unit with the right combination of beam capacity, counterbalance and peak torque for your well . . .

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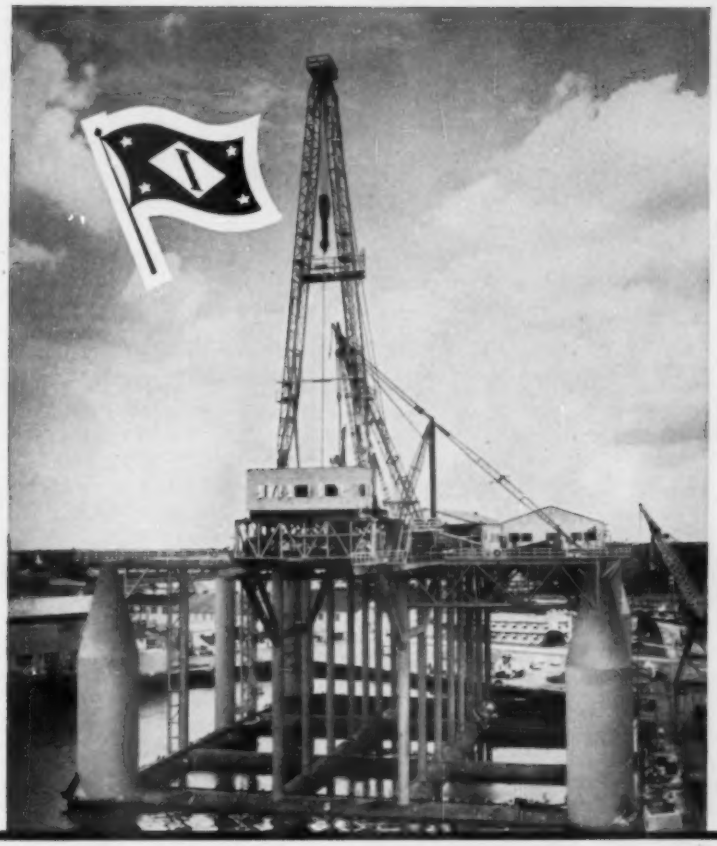

BLUE WATER NO. 1

...*another example of* INGALLS' SKILL

The INGALLS-built "Blue Water No. 1" is the first submersible offshore drilling platform built for the new Blue Water Drilling Corporation. It is the prototype of a new design in offshore "rigs"... a design already proved in offshore drilling operations. Commissioned September 6, 1957, this huge new "rig" is capable of drilling six wells without relocating in water up to 70 feet deep. It measures 242 feet in length, 202 feet in depth, 262 feet from barge to top of mast... has a helicopter landing deck... and provides air-conditioned accommodations for a crew of 50. The "Blue Water No. 1" is one of many INGALLS-built "rigs" exploring new oil frontiers along the Gulf's Continental Shelf.

If your next offshore drilling job calls for imagination and economy, experience and technical skills... consult a specialist—INGALLS.

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Executive Offices: Birmingham, Alabama

Branch Offices: New York, Washington, New Orleans, Chicago, Philadelphia, Atlanta, Houston

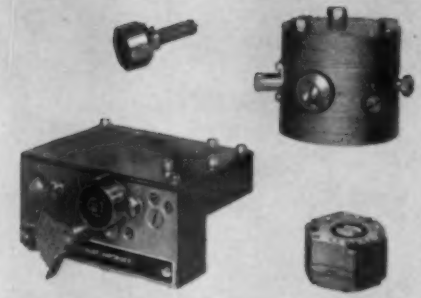
Shipyards: Pascagoula, Mississippi; Decatur, Alabama; Arnold V. Walker Shipyard, Inc., Pascagoula, *a subsidiary*

Complete Dry Docking Facilities at Ingalls Decatur yard

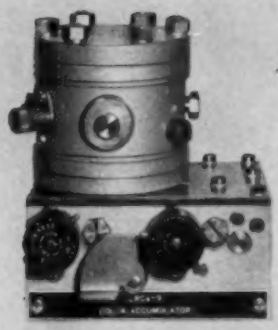
Additional Marine Ways at its subsidiary, the Arnold V. Walker Shipyard, Inc., Pascagoula, to handle all types of repair work

DESIGNERS AND BUILDERS of Offshore Service Vessels, Commercial and Drilling Barges, Tankers, Naval, Merchant Vessels

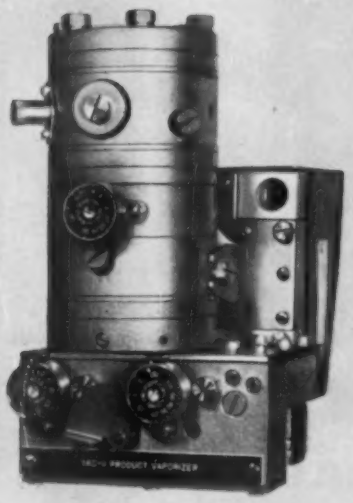
ENGINEERS: for jobs with a future, contact Ingalls today



Easily disassembled—Unitized construction of all controller components simplifies maintenance . . . makes reassembly foolproof. No need to dismantle stack to clean pilot assembly.

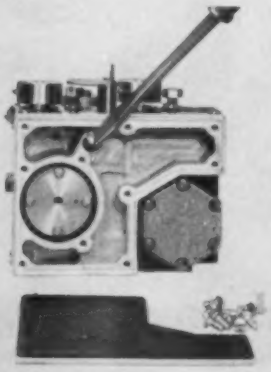


Easy accessibility—All adjustments, filters, and restrictions are easily reached on the face of the controller. Control action is reversed by turning reversing plate 90 degrees.

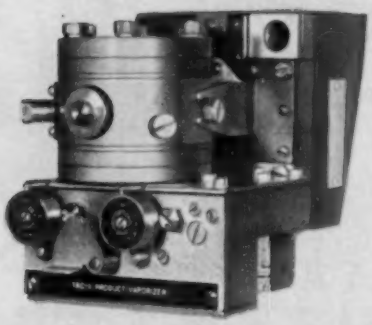


Rate action easily added—Add rate action simply by removing deviation section, inserting longer studs and rate unit, and replacing deviation section.

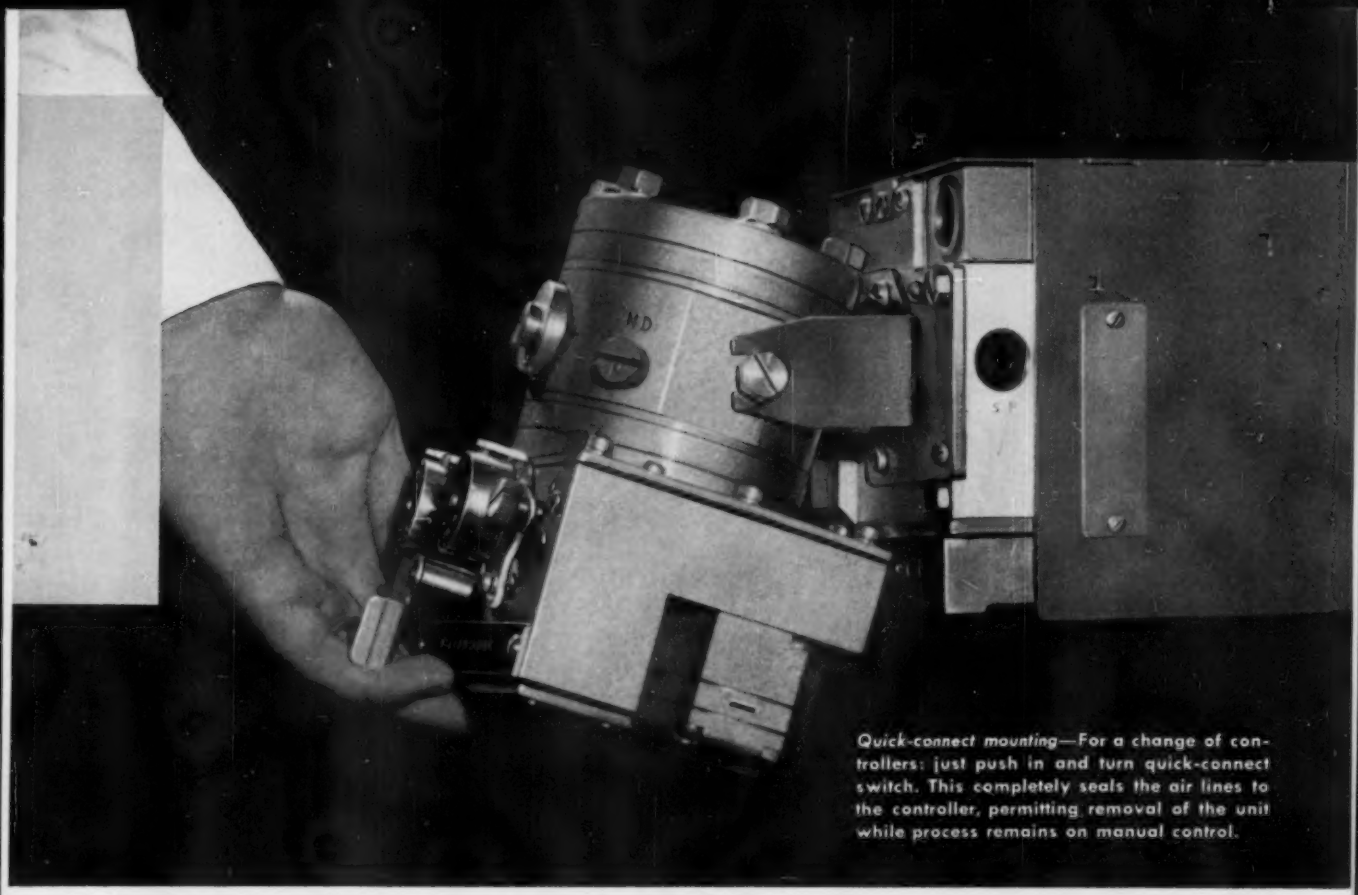
Save with the simplicity of



Three ranges of reset rates—Move a single sealing screw for choice of three reset ranges: 0.2-100, 0.01-5, or 0.04-20 repeats per minute.



Field-mounting manifold—Furnished for installations where controller is not mounted on the recorder. Has same quick-connect arrangement as rear of recorder, and external reset feedback or bypass relay for bumpless transfer from automatic to manual control.



Quick-connect mounting—For a change of controllers: just push in and turn quick-connect switch. This completely seals the air lines to the controller, permitting removal of the unit while process remains on manual control.

TEL-O-SET* controllers

New and improved *Tel-O-Set* controllers are low in cost, easily installed, compact, and require minimum maintenance. You can use them to control any process variable. One basic model serves for all applications. You can mount the controller anywhere: rear of receiver case, back of panel, or on the valve.

With all their simplicity, these instruments are highly sensitive and respond instantly to change. They operate on a pneumatic-balance principle which eliminates lost motion and friction.

Tel-O-Set controllers are an ideal complement to *Tel-O-Set* recorders and indicators... today's most advanced miniature instruments. For details, call your nearby Honeywell sales engineer. He's as near as your phone.

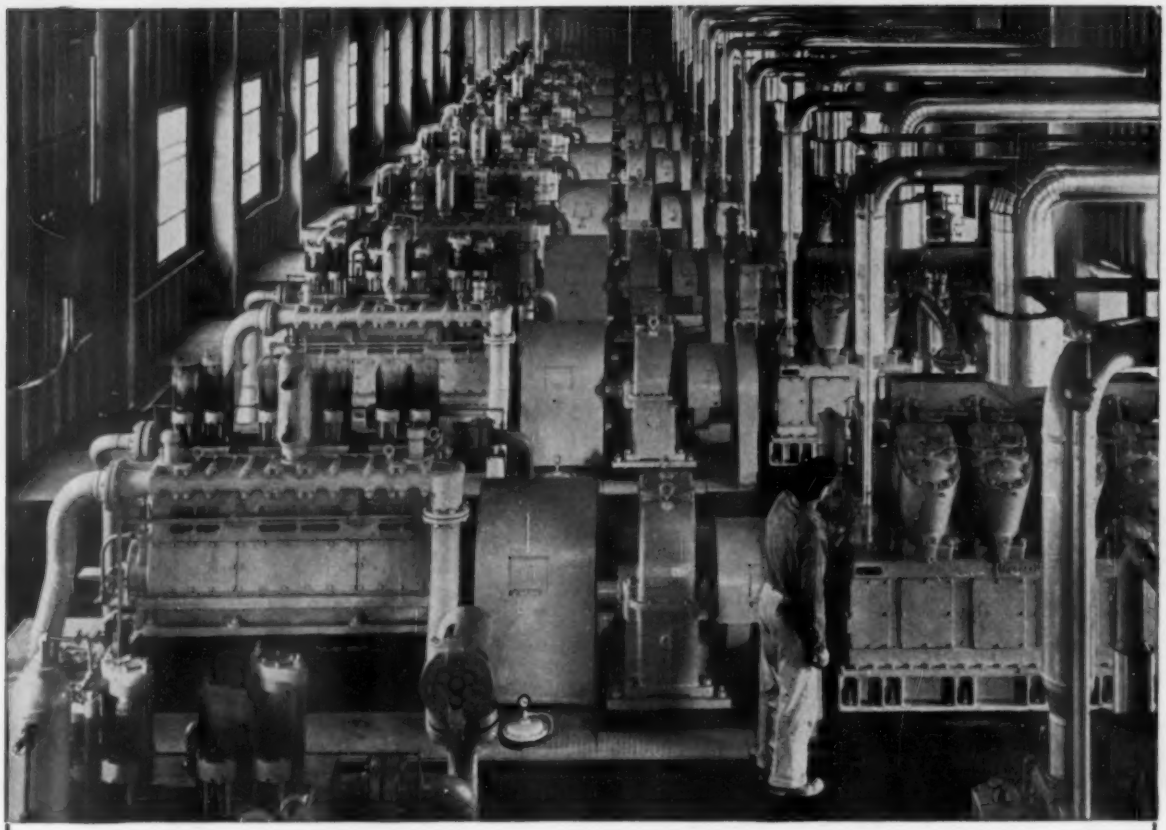
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

*Trademark of Minneapolis-Honeywell Regulator Co.

Honeywell

H HONEYWELL

First in Controls



FIELD REPORT

FLOOD: North Ward-Estes Unit

PUMPS: 10 Aldrich Septuplex

FLOODING STARTED: December 1954

EXPERIENCE TO DATE:

Pumps operate constantly — 168 hours per week. There have been no breakdowns ... customer reports installation highly satisfactory ... "Maintenance actually has been less than we expected."

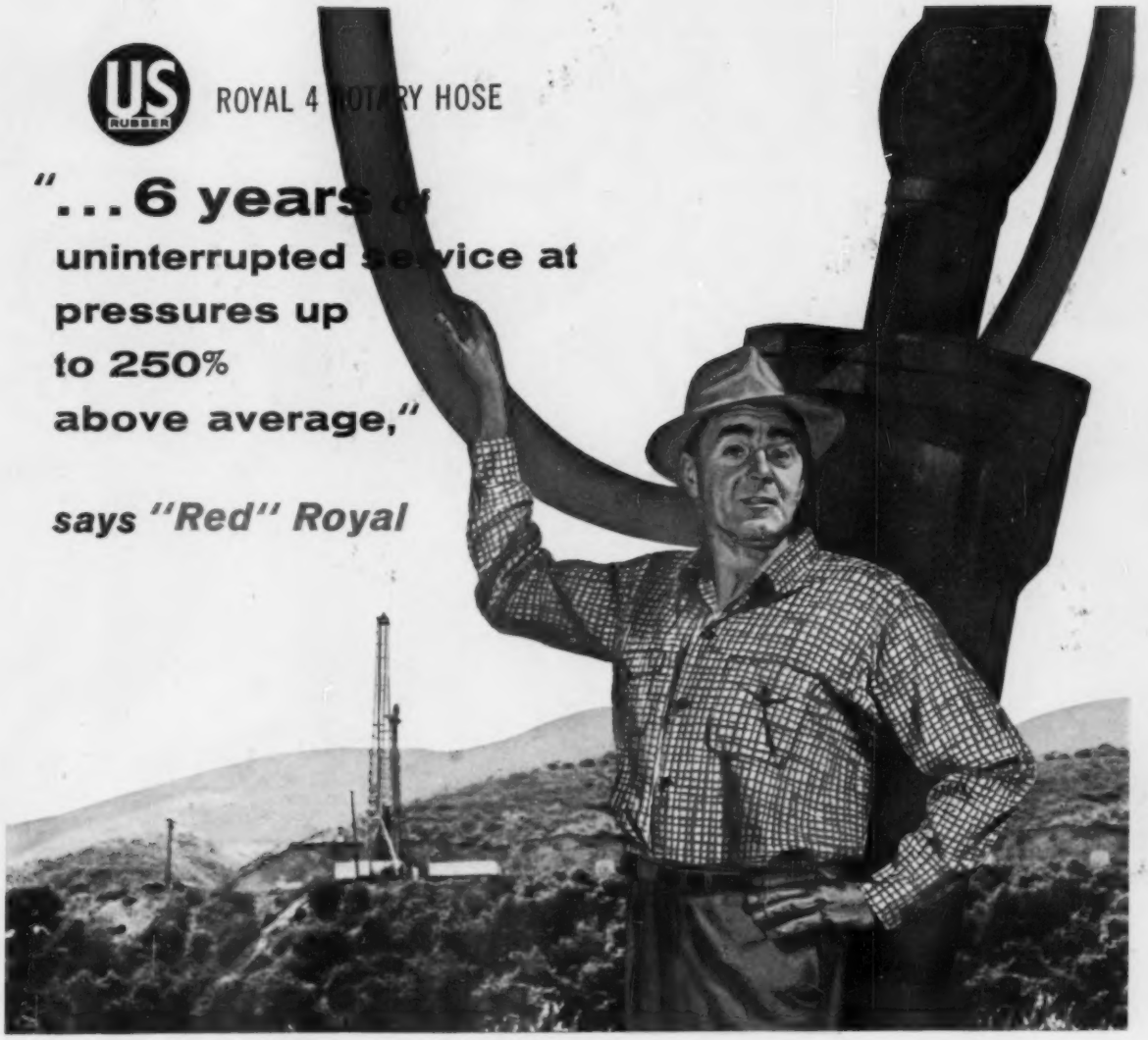
Field parts stock available in Carmi, Ill., Charleston, W. Va., Houston, Los Angeles, Odessa and Tulsa. For further information, write the Aldrich Pump Company, 3 Gordon Street, Allentown, Pa.

the toughest pumping problems go to ALDRICH

US RUBBER ROYAL 4 ROTARY HOSE

"...6 years of uninterrupted service at pressures up to 250% above average,"

says "Red" Royal



"Red" is talking about U. S. Royal 4 Rotary Hose performance at Shell Oil Company's field in Ventura, California. This particular hose was installed in 1951. It has handled pressures that often hit 3000 lbs., compared to standard operating pressures of 1200 to 1400 lbs.

What's more, this Royal 4 is one of the most traveled rotary hose in the West, taking all the extra punishment involved in moving around the rough California terrain. Yet, from the day it was put on its first rig, *this Royal 4 has never caused one minute of downtime.*

The hose has drilled over 300,000 feet so far, most of the time carrying oil-base mud. The Ventura field is one of the deepest in California and requires the best hose there is. And that's U. S. Royal 4 Rotary Hose—the hose that takes the highest pressures delivered by today's pumps, with a margin to spare for the pumps to come.

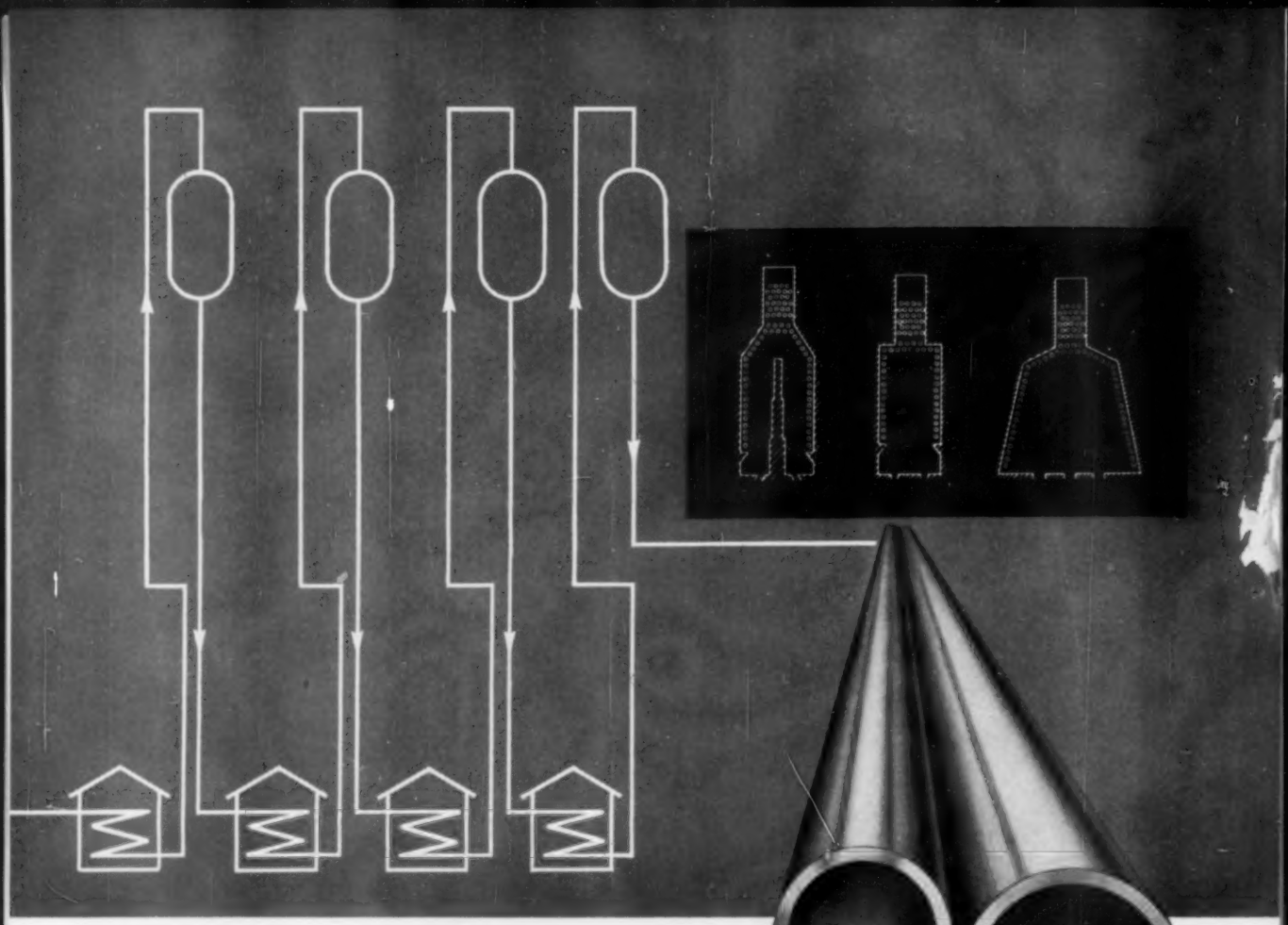
So don't tie up money in stand-by hose . . . avoid downtime needed for switching. Use Royal 4 all the way from spud to pay.

Available in all fields at supply stores.
(In California, contact U. S. Rubber District Office, Los Angeles.)

US RUBBER **Mechanical Goods Division**

United States Rubber

See things you never saw before. Visit U. S. Rubber's New Exhibit Hall, Rockefeller Center, N.Y.



HOW MANY PROBLEMS IN THIS PICTURE?

Some layouts present a multiplicity of engineering, purchasing, warehousing and financing problems. Conceivably, (1) Return bends have to be designed for a perfect fit on their heater tubes, (2) Both tubing and fittings must meet the same exacting customer standards, (3) Simultaneous delivery must be made to guarantee erection schedules, and (4) Money tied up in material in process at any one time must be kept to a minimum.

In such a situation, it's best to depend upon Mr. Tubes for coordinated delivery of perfectly matched tubing and fittings.

Think of your own requirements in terms of the right tube for the job, tubing (or alloy pipe) and welding fittings and forged steel flanges as components of an integrated system—and you'll make B&W's Mr. Tubes a member of your team. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

B&W

TUBULAR PRODUCTS DIVISION

TA-6085-PP-1

Seamless and welded tubular products, seamless welding fittings and forged steel flanges in carbon, alloy and stainless steels

Producing

WITH J&L SUPPLY

The producer's best friend is J&L Supply. J&L stores, sales offices, and a vast network of resident salesmen in the United States and Canada provide active and stand-by service from flush production days through every subsequent phase of recovery. No other organization offers the producer so rich and convenient a source of practical experience and proven equipment.

The technical information, the interest, and the natural enthusiasm of J&L Supply men can be employed to advantage in the selection of casing, as in the design of special strings. J&L Supply service plus the exceptional quality of the product have established for J&L Seamless a remarkable record for satisfactory performance. Casing sizes from 4½" to 13⅜" O. D. Grades H-40, J-55, N-80, and P-110. T & C with API threads. Now also available in Buttress Thread and Extreme Line Joints.

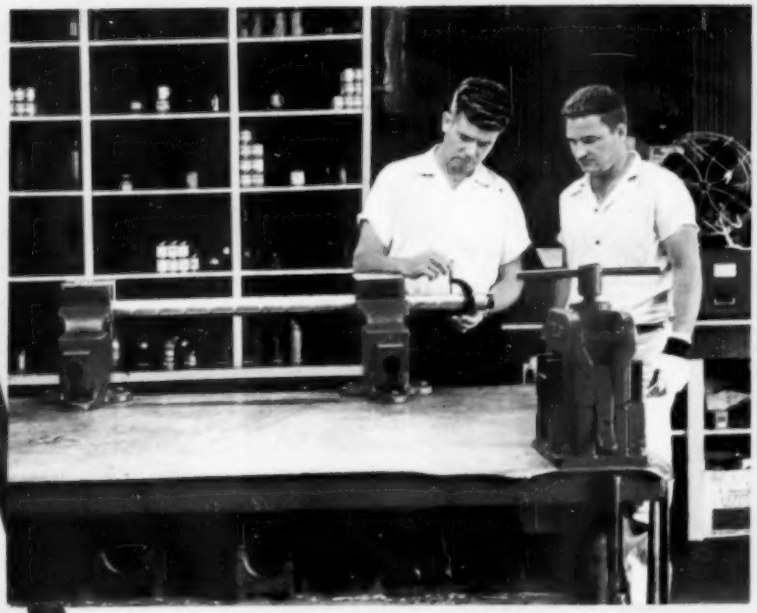
J&L

A well has greater promise of trouble-free production when both casing and tubing are J&L Seamless. J&L Supply men stand by 24 hours a day, eager and qualified to be helpful. API tubing 2⅜" thru 4½" O. D. Non-upset or external upset. J&L Integral joint in 2⅜" and 2⅞" O. D. J-55, N-80, and P-105 grades.

Further logical steps in safeguarding production — Axelson rods, an Axelson pump, and a Cabot unit. J&L Supply men have a vital stake in such a well. They tailor-assemble the pump to fit the job. The rods have been heat treated and normalized from end to end to guard against failure. The Cabot unit incorporates every device of known value for preserving the useful life and promoting the satisfactory performance of rods and pump.

Only a pumping unit with no moving parts, if such a thing were possible, could be more dependable than a Cabot. Cabot design and construction have one objective: steady production with minimum upkeep for the unit and the equipment it activates. Patented rubber tail bearing intercepts fatigue-creating stress. Sykes-cut herringbone gears, flood lubricated. Timken and Hyatt bearings. One-man crank achieves positive balance. Right, powered with a Century motor; a top performing team.

J&L Supply service adds to the downright pleasure of owning a Cabot anywhere in the United States or Canada. Not only are parts immediately available, but J&L men take an active, helpful interest in Cabot performance. Maximum polish rod loads from 3,000 to 32,000 lbs. Standard equipment: floor clearing subbase, V-belts, belt guards, adjustable slide rails. Left, Cabot's largest unit powered with Type "O" Lorain engine. API walking beam rating 33,160 lbs.; strokes to 144"; API peak torque at 20 S. P. M. 456,000 inch-lbs.



Pump shops are maintained by J&L Supply in the United States and Canada to tailor-assemble an Axelson pump for maximum production on any given job, and to keep that pump in perfect condition for the life of the well. "Never junk an Axelson" is a phrase coined in tribute to the efficiency and complete parts inventories of these J&L pump shops. Pictured here, the shop in Laurel, Mississippi, with J&L Supply men assembling an Axelson Sure-Seal solution to a local production problem.

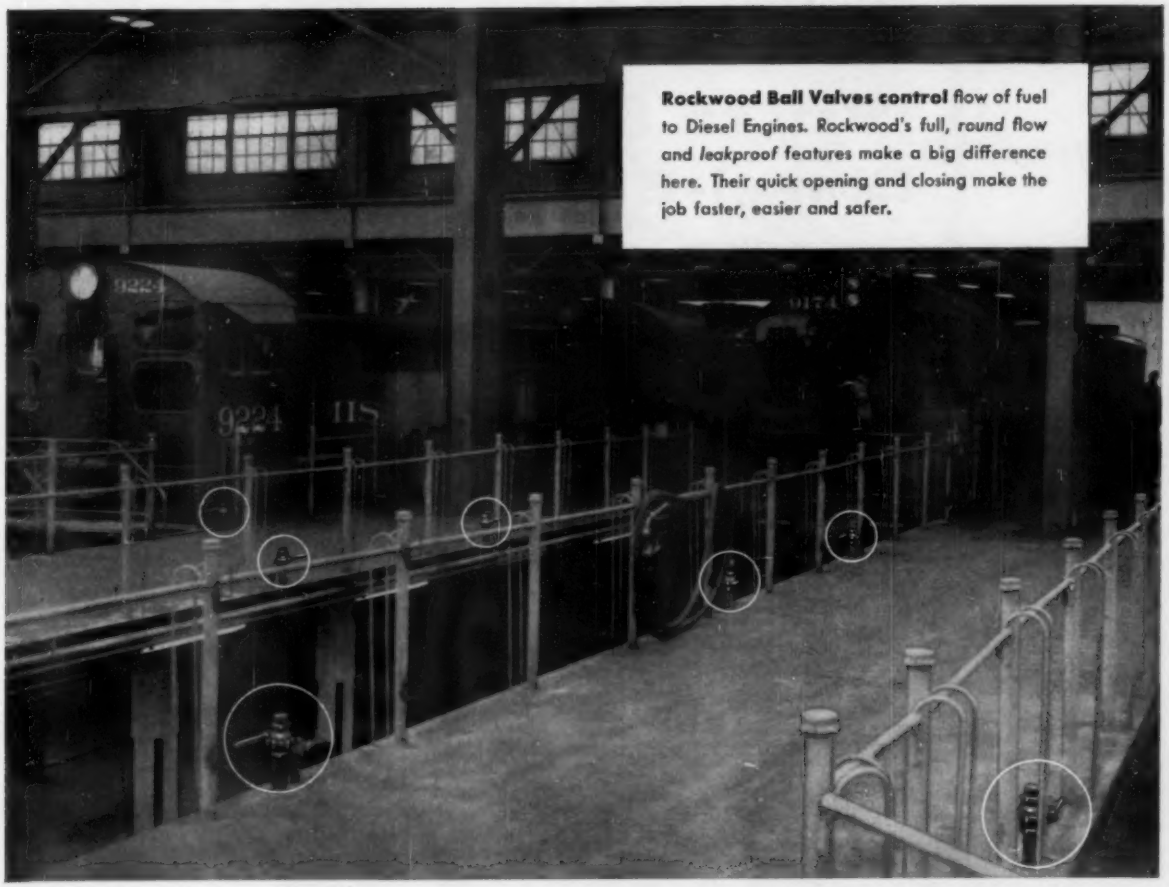
Production everywhere gets a mighty lift from J&L Supply. Each store profits from J&L production equipment experience throughout the United States and Canada, and is stocked to provide one-stop service geared to the requirements of the area served. You'll enjoy doing business with an organization dedicated for more than fifty progressive years to the customer's logical objective: PRODUCING FOR MORE PROFIT. For real cooperation, get your J&L store on the telephone!

Jones & Laughlin

SUPPLY DIVISION – Tulsa

J&L – A GREAT NAME IN SUPPLIES

36-I



Rockwood Ball Valves control flow of fuel to Diesel Engines. Rockwood's full, *round* flow and *leakproof* features make a big difference here. Their quick opening and closing make the job faster, easier and safer.

Flammable liquids handled with safety ... without leakage ... without delay

Rockwood Ball Valves are ideal for handling flammable fuel oils. They handle quickly, easily! The reasons are —

Rockwood Ball Valves with *Full Round Flow* eliminate turbulence and provide minimum friction loss.

Only a quarter turn is needed to open or close the valve.

Rockwood Ball Valves have a chrome-plated ball that holds up under tough abrasion, pitting and scratching — that means *Long Wear-Resistance.*

Rockwood exclusive corrugated spring design and the pressure of the fluid *automatically* position the ball against the seat for a completely *Leakproof Seal.*

These features pay off on handling fuel oils. Rockwood Ball Valves deliver flammable fluids at the volume you want quickly, without leakage and a minimum of maintenance. The only other thing you could ask for is more information — and the coupon below will get it for you.

Tested and listed by Underwriters' Laboratories, Inc. Distributors in principal industrial areas.

ROCKWOOD BALL VALVES

FULL, ROUND FLOW

ROCKWOOD

ROCKWOOD SPRINKLER COMPANY
2206 Harlow Street
Worcester 5, Mass.

Send me illustrated folder V-4 on Rockwood Full-Flow Ball Valves.

Name.....

Title.....

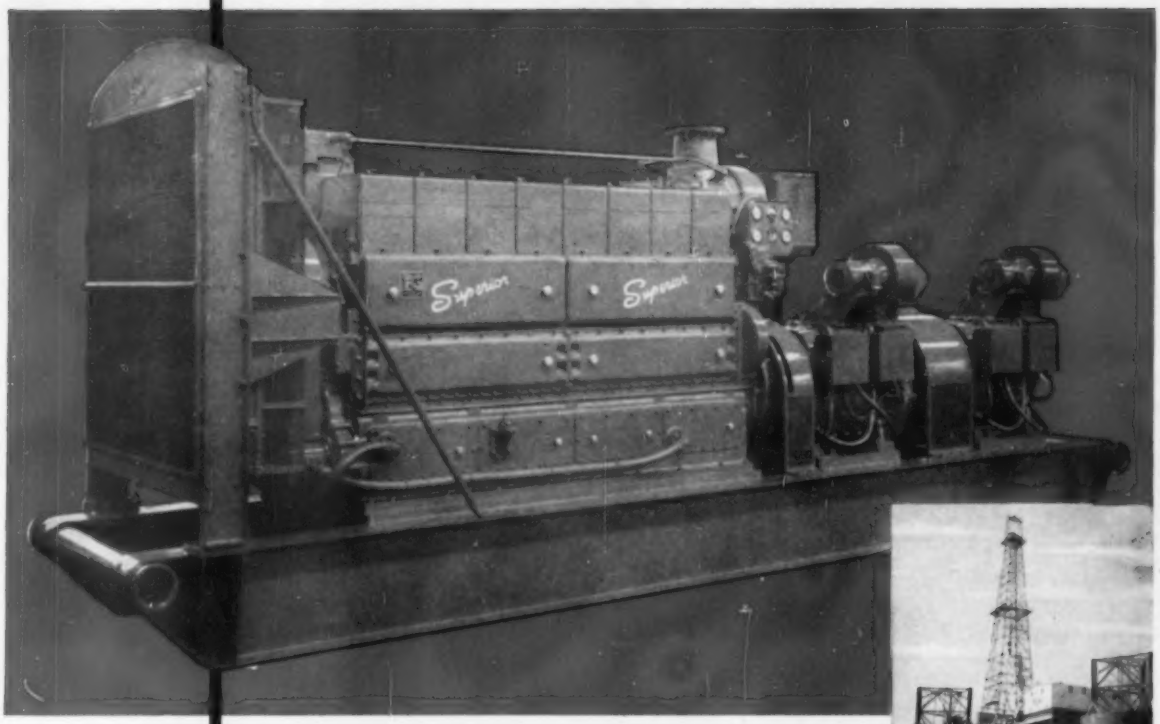
Company.....

City.....

Zone.....*State*.....

Dixilyn Drilling selects . . .

WHITE'S Superior Diesel-Electric



Lighter, extremely simple, more powerful drilling rig power plant!

Dixilyn Drilling Corporation of Odessa, Texas wisely chose White's Superior Diesel-Electric power for drilling operations to over 25,000 ft. deep from their LeTourneau mobile tripod platform, off the Louisiana Gulf Coast. The platform's 175 ft. spuds will permit drilling in approximately 105 ft. of water. The complete power package, including three 834 h.p. Superior engine-generator sets, will dependably provide a total of more than 2,500 h.p. From simplified controls, the driller can direct 2,000 h.p. to a National 1625 drawworks, or 2,000 h.p. to the mud pumps. Operational headquarters for the rig will be Morgan City, La.

More power for faster, deeper drilling—land or offshore, plus smoother overall performance, quicker response and extreme simplicity in arrangement and operation are the results of White's new important advancements and design refinements.

Components consist of 2 or more engine-generator sets, a minimum of 3 drive motors, and simple controls. White's well-known Superior oil field engine and rugged 300 to 550 kw generators in tandem make up an engine-generator set. Total weight of one set alone is almost 8 tons lighter than comparable units!

Power concentration in the heavy-duty drive motors also achieves simplicity, compactness and lighter weight. Largest drive motors are rated 1000 h.p. continuous and 1250 h.p. intermittently. This permits use of only one motor for the drawworks and one for each mud pump. Multiple motor linkages are unnecessary and controls are greatly simplified. All components are stocked, standard production items, ready for prompt delivery.

Get complete information from leading rig manufacturers, White's oil field representatives, or through White Diesel Engine Division.

White Diesel

WHITE DIESEL ENGINE DIVISION
THE WHITE MOTOR COMPANY

Plant and General Offices: Springfield, Ohio

Brown . . . The Company that has PULL - - in mind when recovering a fish

With a Brown man on your fishing or pulling jobs you get the benefit of years of experience, fishing operation skill and know-how, full knowledge of fishing tools . . . their uses, capabilities, and limitations.

You get the benefit of Brown manufacturing know-how. This is displayed in the Brown Hydraulic Pulling Tool. The principle of hydraulics is built into this tool in a simple manner, yet the pulling power is tremendous. This means economy and efficiency. Take advantage of the service offered by Brown Oil Tool on your next fishing job.

Brown Hydraulic Pulling Tool
Can be sold for Export
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NORDBERG

MEMO TO: Management

After investigation and full consideration of all facts this committee recommends the installation of Nordberg engines for this pipeline project.

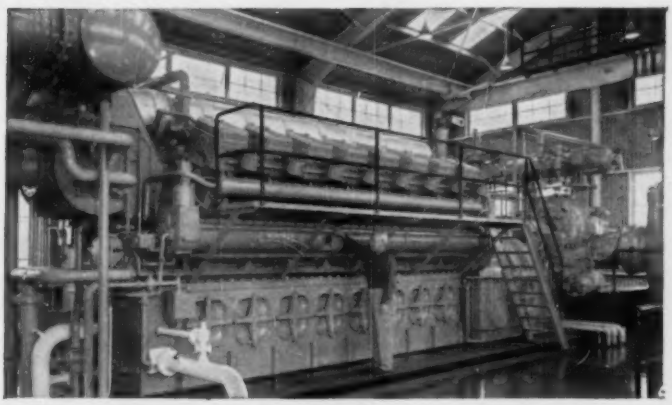
Chairman, Technical Committee

The Scene: Office of the Vice President in Charge of Operations, major gas transmission company.

The Problem: Selection of engine compressor units for gas pipeline expansion.

Recommendation: Install Nordberg *Supairthermal*® gas engine gear sets driving centrifugal gas compressors.

The Reason: Because the Nordberg units can be installed with lower capital investment, and operated at lower cost per horsepower-hour.



Nordberg Supairthermal **Engines are, by all standards, your best investment in modern prime movers for compact, economical, long term pipeline power. These powerful engines are built in both In-line and V-types, in sizes from 500 to 4,500 horsepower for Diesel, Duafuel® or Spark-Ignition Gas operation.**

Consult Nordberg on your next expansion program.

NORDBERG MFG. CO., Milwaukee, Wisconsin

NORDBERG

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

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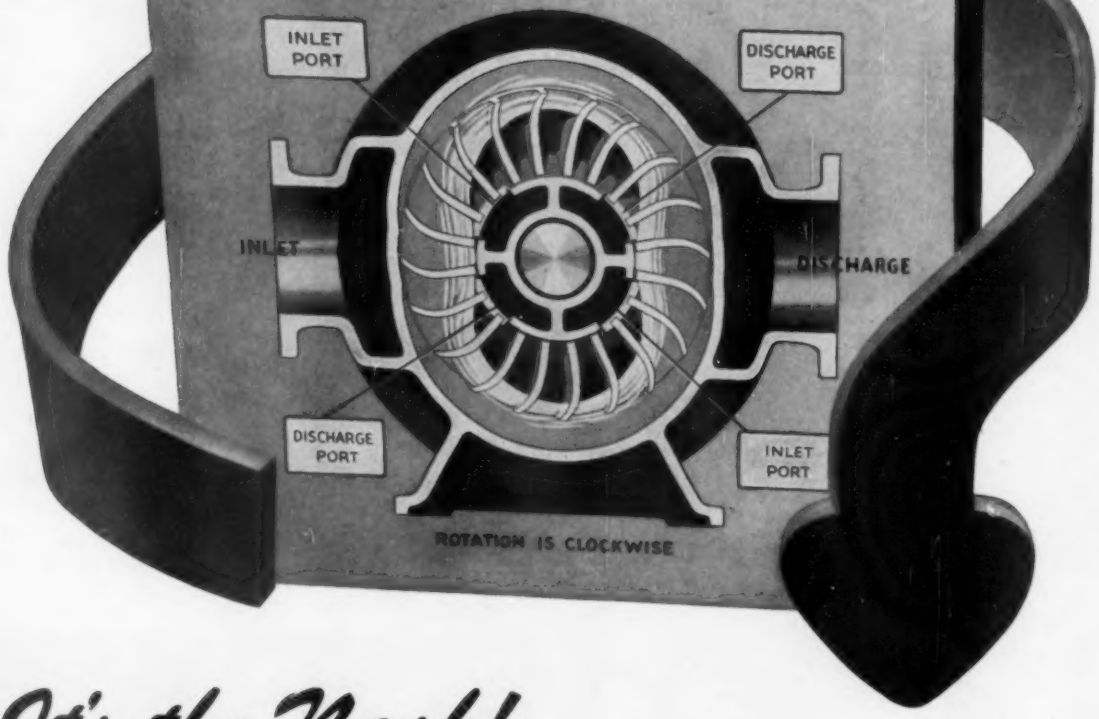
O157-R

This is Why the Nash is the Most Simple Compressor



It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

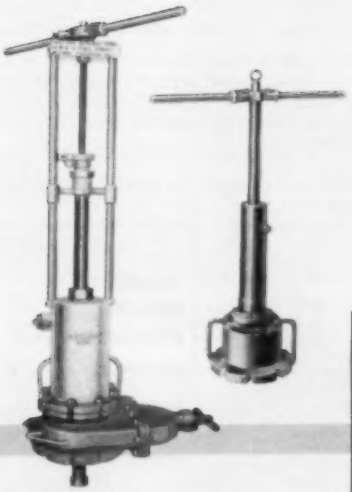
Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY
313 WILSON, SO. NORWALK, CONN.

relocate! isolate! tie-in! sections of 6" and 8" lines *under pressure!*



any of these operations can be performed in complete safety with Mueller® No. 3SW Line Stopper Equipment.* Continual flow of fluid may be maintained by using a built-in, or if preferred, a completely separate by-pass line.

Mueller welding or mechanical joint line stopper fittings are equipped with a completion plug incorporating an equalizing valve. This valve maintains equal pressure on both sides of the completion plug and assures easy insertion or extraction under pressure. An "O" ring seal on the completion plug prevents leakage of fluid.

NO. 3SW LINE STOPPING UNIT

Two H-17340 Steel Wedge Stopping Machines and one H-17346 Completion Machine make stop-off and plug the fittings.

WELDING FITTING

Available with 150, 300, 400 or 600 pound flanges for pressures to 1200 p.s.i. at 100° F. Sizes 6" and 8".

MECHANICAL JOINT FITTING

Used where welding is not desired on either steel or cast iron pipe. Pressures to 175 p.s.i. at 100° F. Sizes 6" and 8".

NO-BLO®

* *Write for complete information on this and other Mueller Line Stopper Units and Fittings for lines from ¾" through 12".*

MUELLER CO.
DECATUR, ILL.

Factories at Decatur, Chattanooga, Los Angeles, In Canada: Mueller, Limited, Sarnia, Ontario

Since 1857

Kaiser Aluminum sheet for jacketing offers new economies through improved application methods

Recent developments make possible new low costs for the power, refinery and chemical industries

As you can see in the relative cost charts at the right, aluminum sheet jacketing now offers the *lowest first cost* of four well-known finishing methods for pipe insulation . . . and it offers *lower first cost* than wet-construction finishing methods for vessel insulation.

Another important fact, not revealed in the charts, is that aluminum's first cost is becoming *increasingly* competitive, thanks to newly-developed methods that speed application and reduce labor costs!

And if maintenance costs were added to the comparisons, aluminum would present an *even better value*—because only aluminum eliminates maintenance.* Its remarkable resistance to corrosion eliminates the need for painting . . . even when exposed to weather and mechanical abuse.

New Dry Wall Construction for Vessels

A number of improvements in application technique—developed by Kaiser Aluminum engineers in cooperation with specialists from various industries—adapt dry-wall type construction to the finishing of large cylindrical and flat insulated surfaces. These techniques virtually eliminate the need for costly application methods used to apply wet materials such as insulating cements, emulsions, mastics, adhesives, glue sizing and paint. Where corrugated aluminum sheets are used, positioning and fastening are simplified and speeded by familiar techniques employed for block insulations.

New "Snap-Back" Aluminum Jacketing Speeds Installation on Piping

Aluminum's unique advantages in light weight and superior workability have made possible greatly simplified preformed "snap" jackets for quick, easy application on piping.

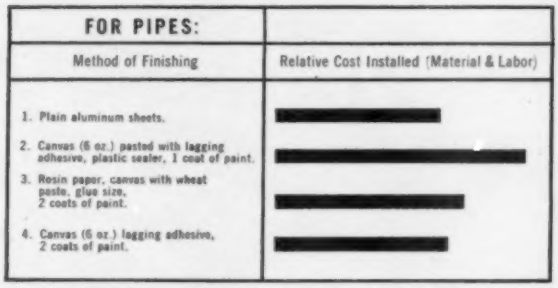
Jacketing, preformed into undersize tubes from stiff sheets of aluminum, will snap back to a tight fit when placed over pipe insulation, freeing both hands for fastening. This tight fit requires less fasteners per running foot.

The following is an outline discussion of important factors in aluminum jacketing materials and alloys, with suggested application methods best suited to various insulated surfaces, including pipes, vessels, vessel heads and others.

The Jacketing Alloys

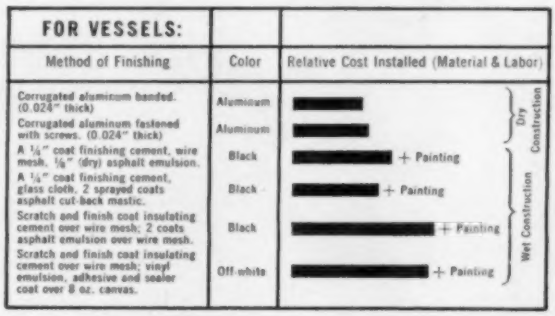
The following aluminum alloys, supplied in flat or coiled sheets, are successfully used for insulation jacketing: 1100, 3003, 3004, 5005, 5050, 5052, Kaiser Aluminum industrial roofing and siding alloy, and Kaiser Aluminum standard roofing alloy.

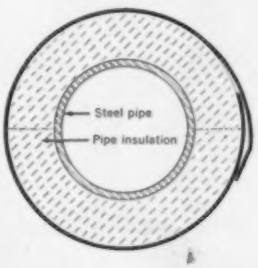
*Roofing felt has a lower initial cost than aluminum, but painting and maintenance offset this initial cost advantage.


FOR PIPES:
Method of Finishing
Relative Cost Installed (Material & Labor)
1. Plain aluminum sheets.
2. Canvas (6 oz.) pasted with lagging adhesive, plastic sealer, 1 coat of paint.
3. Rosin paper, canvas with wheat paste, glue size, 2 coats of paint.
4. Canvas (6 oz.) lagging adhesive, 2 coats of paint.

Results of first cost analyses of various insulation finishes

NOTE: Charts show first costs only. To arrive at total costs, maintenance costs must be added. Whereas other finishing methods require frequent and costly maintenance, aluminum jacketing is virtually maintenance-free.


FOR VESSELS:
Method of Finishing
Color
Relative Cost Installed (Material & Labor)
Corrugated aluminum banded. (0.024" thick)
Aluminum
Corrugated aluminum fastened with screws. (0.024" thick)
Aluminum
Dry Construction
A ¼" coat finishing cement, wire mesh, ⅛" (dry) asphalt emulsion.
Black
+ Painting
A ¼" coat finishing cement, glass cloth, 2 sprayed coats asphalt cut-back mastic.
Black
+ Painting
Scratch and finish coat insulating cement over wire mesh; 2 coats asphalt emulsion over wire mesh.
Black
+ Painting
Scratch and finish coat insulating cement over wire mesh; vinyl emulsion, adhesive and sealer coat over 8 oz. canvas.
Off-white
+ Painting
Wet Construction



Sketch shows how preformed jacketing snaps back over piping, providing quick installation combined with tight fit. This is also demonstrated in photo titled "Teamwork."

Based on maximum economy and performance, the general recommendation is the use of Kaiser Aluminum alloy 5005 and Kaiser Aluminum industrial roofing and siding.

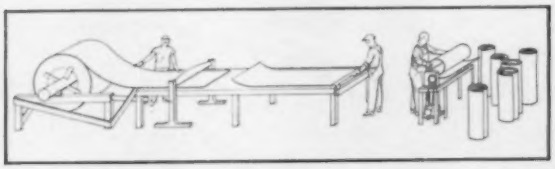
The reasons for this recommendation, and the exceptions to it, are as follows:

(a) Alloys in the 5000 series (which contain magnesium as the principal alloying element) and the clad alloys, such as AlClad 3004 (from which Kaiser Aluminum industrial roofing and siding sheet is made), offer superior corrosion resistance—especially in marine atmospheres.

(b) Alloy 5005 and the industrial roofing and siding alloy provide top performance at lowest cost for most jobs. Alloy 5050 shows an advantage from the standpoint of strength over 5005, and in many instances its slightly increased cost (a fraction of a cent per square foot) is warranted. Where exceptional strength is required, alloy 5052 should be used.

(c) Closely allied with alloy selection is a consideration of the section modulus of jacketing for large diameter vertical vessels. Kaiser Aluminum industrial roofing and siding sheet is superior in section modulus. On certain vertical vessels, usually those in the range of 3′ to 12′ in diameter, some designers prefer the close-up appearance of smaller corrugations. When this is preferred, most of the common alloys and the standard corrugated roofing alloy are satisfactory. Sheets should be 0.024″ thick, embossed, corrugated to 1¼″ x ¼″, and supplied in finished widths of 26″.

A metal thickness of 0.024″ is recommended in most cases. Corrugated aluminum 0.024″ thick can be banded at less material and labor cost than the thinner 0.019″ material fastened with screws. For insulated pipes with an O.D. of 12.75″ and less, 0.020″ thick aluminum sheet is recommended.



These illustrations show method used to fabricate snap jackets:

1. Using aluminum of proper alloy and temper . . .
2. Cutting it to proper dimensions for easy, economical installation . . .
3. Properly stiffening the overlapping edge by a simple angular crimp . . .
4. Forming it through a roller for proper circumference . . .
5. Snapping it around insulated pipe (below).

Teamwork—with one man to snap jackets in place and another to band them, two men can cover 700 feet of 10-inch diameter tubing in one day!

The best temper for pipe jacketing is ¾ hard, designed as H-16 or H-36. For fitting jackets requiring numerous lock seams, ½ hard temper, H-14 or H-34, is recommended.

Pipe Jackets

Snap jackets are a quick, easy and economical method of enclosing insulated pipe. The simple process shown above produces a most effective jacket for pipe insulation. (Kaiser Aluminum's booklet, *"Insulation Jacketing Materials and Methods."* explains and describes the process in full detail.)

The alloy recommended is 5005-H16, in coiled sheet form with plain finish. Embossed finishes are also available. Other alloys may be used, but it is desirable to use one alloy throughout. Width of coiled sheet should be 36″. Recommended thicknesses of sheets are 0.020″ for insulation O.D. of 12.75″ and under, and 0.024″ for insulation O.D. of 14″ and larger.

Vessel Jackets

Insulated vessels 36″ O.D. and less—horizontal or vertical—should be jacketed with 0.024″ thick by 36″ wide 5005-H16 alloy sheet, plain finish preferred.

For insulated vessels larger than 36″ O.D., horizontal mounting, use the same coiled sheet as above; for vertical mounting, use Kaiser Aluminum industrial roofing and siding, 0.024″ thick, embossed finished, ⅞″ deep corrugations with 2.67″ pitch.

Jackets for Large, Flat Surfaces

For breechings and ducts, indoors and out, Kaiser Aluminum industrial roofing and siding, 0.024″ and 0.032″ thick and having ⅞″ deep by 2.67″ pitch corrugations are most economical. Flat sheet, fluted sheet, and flat sheets stiffened with roll-formed standing seams offer other possibilities.

For insulated boiler walls, jackets may be made of aluminum sheets of several types. Thickness, size and fastening method will vary with specific boiler designs.

Fasteners

For pipes and vessels with insulation O.D. 36″ or smaller, bands may be slit from the same aluminum sheet used for pipe jackets, or they may be purchased as standard stock items. For pipe insulation O.D. 12.75″ and smaller, bands should be ½″ wide by 0.020″ thick, equal to A. J. Gerrard #305-AL; seals should be equal to A. J. Gerrard #202-AL. For pipe or vessels with insulation O.D. 14″ to 36″, bands should be ¾″ wide by 0.020″ thick, equal to A. J. Gerrard #311-AL; seals should be equal to A. J. Gerrard #204-AL. For vessels with insulation O.D. 36″ and larger, ¾″ wide by 0.020″ thick #18-8 stainless steel expansion bands should be used. Banding should be equal to A. J. Gerrard Expand-R-Strap, #E311 ½ S-4; seals should be #18-8 stainless steel, equal to A. J. Gerrard #204-SS.

When required for pipe and fitting jackets, #7 by ½″ aluminum pan head self-tapping screws, Type A, are suggested. Side laps and flashing with corrugated vessel jackets should be fastened with #7 x ¾″ aluminum pan head screws, Type A. Aluminum screws should be made from either 6061-T6 alloy or anodized 2024. For fastening aluminum jackets to steel structural members, use #14 hex head screws, Type B, made from stainless steel #18-8 alloy; #410 is acceptable.

Composite studs made from #18-8 stainless steel and aluminum (equal to Nelson Rivweld Studs or to Nelson Set Lock Studs supplied with aluminum washers) may be used to fasten corrugated aluminum jackets to angles. On siding, fasten studs on low part of corrugation. On roofing, fasten studs on crown of corrugation.

Aluminum Jacketing Booklet Available

Kaiser Aluminum's new booklet, *"Insulation Jacketing Materials and Methods,"* gives you complete details on the subjects outlined above. It also presents illustrated step by step application methods plus material and accessories charts to help you take advantage of recent advances in aluminum sheet jacketing. Forty fully illustrated pages in all! To get your free copy, write to: *Kaiser Aluminum & Chemical Sales, Inc., Process Industries Department, 919 N. Michigan Ave., Chicago 11, Illinois.*

KAISER Aluminum

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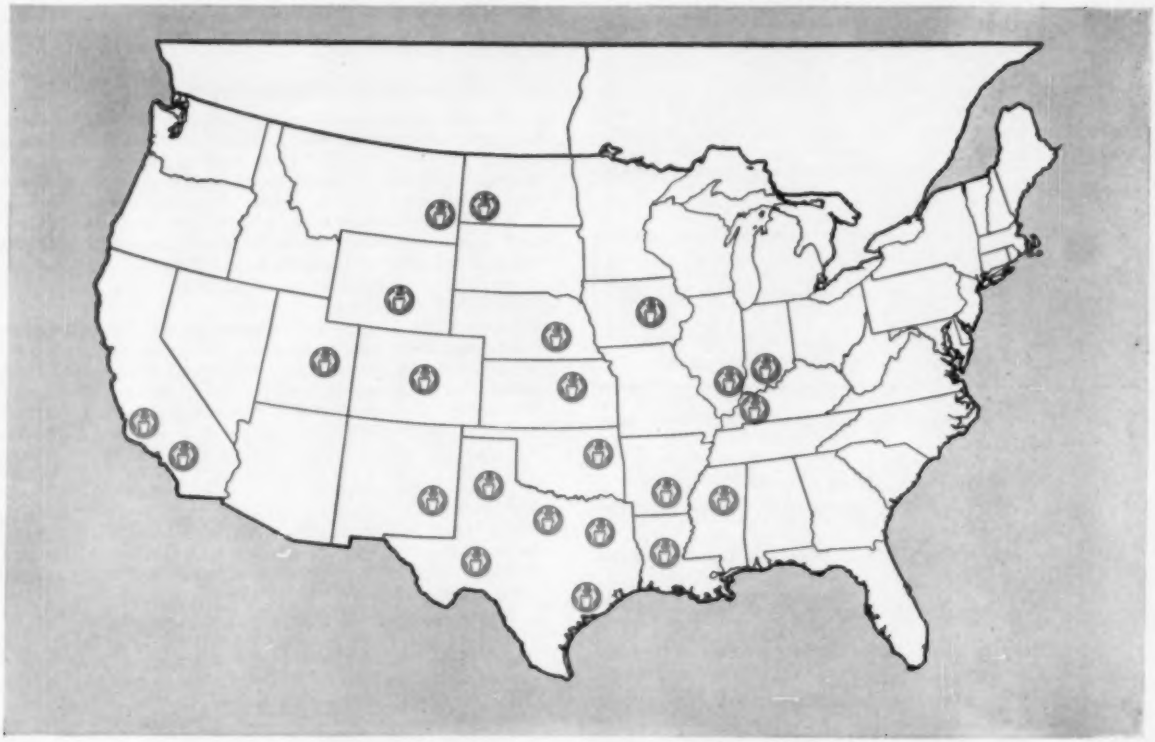

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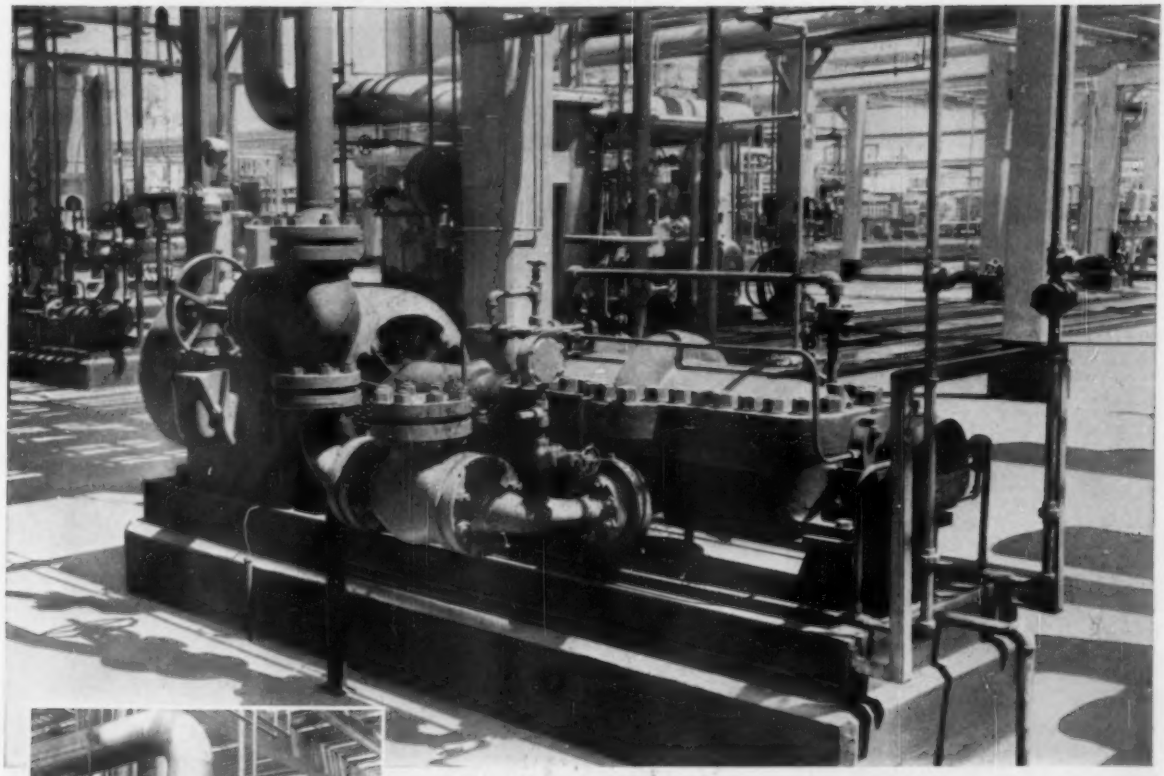
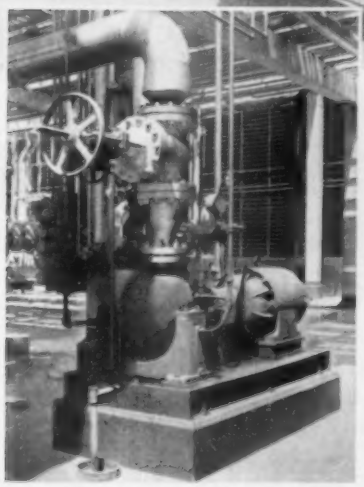
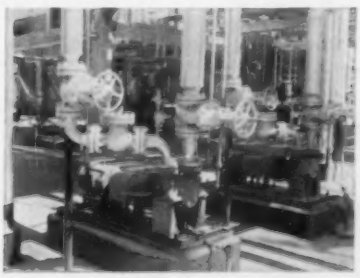


Ingersoll-Rand 200-hp Class CNTA reactor charge pump for Rexforming Unit at Cosden Refinery, handling gasoline at 195 gpm.



Ingersoll-Rand Class HFL extractor charge pump handling hydrocarbon liquid at 200 gpm.



Two Ingersoll-Rand Class SFL pumps for No. 2 tower, handling hydrocarbon feed stock at 80 gpm.

CHARGE PUMPS

at Cosden Rexformer Unit

Ingersoll-Rand Centrifugals put the pressure on high-octane gasoline production at Texas refinery

THE Ingersoll-Rand pumps shown here, handling hydrocarbon charge stocks, are but four of the *thirty* I-R pumps serving the new U.O.P. designed Rexformer Unit at the Big Spring Refinery of Cosden Petroleum Corporation.

These charge pumps, operating at pressures up to 700 psig, are vital to the entire reforming process. Any failures here could shut down the entire unit. That's why the traditional *dependability* of Ingersoll-Rand pumps is a big asset. Their sustained high efficiency and low maintenance are important *economy* factors, too.

The complete I-R line of centrifugal pumps covers every refinery or process plant application, in types, sizes and capacities to meet every requirement to best advantage. To solve your pumping problems *fast*, just call your nearest I-R Branch Office.

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Photo by Elwood M. Payne, Houston

AAF Cycoils play an important part at the Shell Oil Company's Sheridan, Texas cycling plant. Dust stays out of engines and compressors, only *clean* air goes in.

WHEN you have fourteen compressors working full-time, you want to be sure you have complete protection against dust. That's why the Shell Oil Company chose Type W AAF Cycoils for its important gasoline cycling plant at Sheridan, Texas. Only *maximum* protection is enough with an investment like this at stake.

AAF Cycoil heavy-duty oil bath air cleaners deliver 4-way cleaning: impingement, scrubbing, cyclonic action and filtering. Actual tests, plus on-the-job operation, prove that more than 90% of the fine dust content of air is trapped in oil and removed by centrifugal action—*before it even reaches the filter pads.* No wonder Cycoils deliver air that's virtually 100% *dust-free.*

Only AAF Cycoil Oil Bath Air Filters offer engines and compressors such protection, save so much money and trouble. For full information, write today for Bulletin No. 130. It's packed with facts—has all the details.

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"Performance Exceeded Expectations"

"Where does it get all that power?" and "Don't let its size fool you!" are common expressions from owners and operators of John Deere Crawlers.

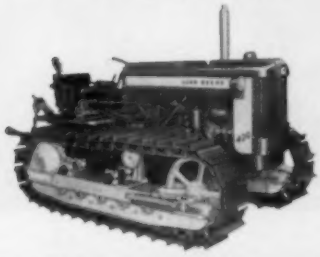
AMONG the many pleasantly surprised users are the Pacific Pipe Line Construction and S. E. Construction folks who used six John Deere Crawlers with angle blades and sideboom attachments in the construction of the gas distribution system in Regina, Saskatchewan, Canada.

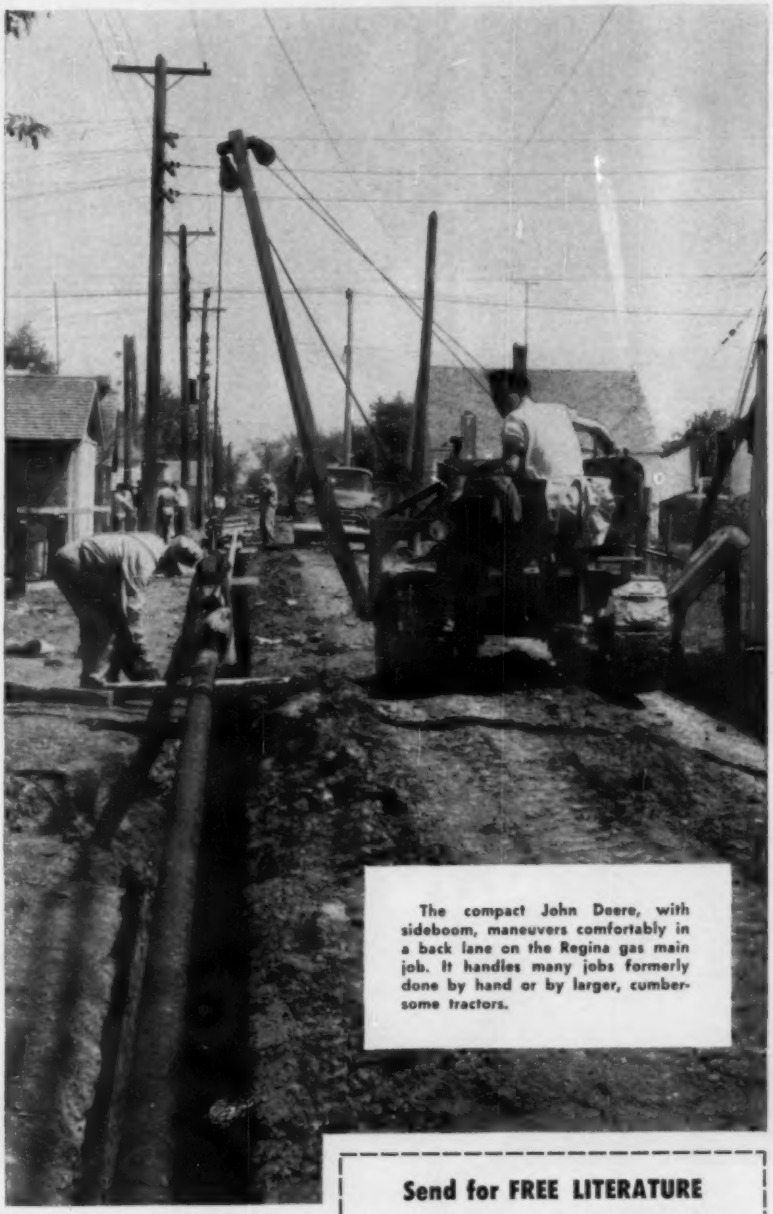
Mr. E. A. Ackerman, project manager, writes:

"The John Deere units were used to handle pipe in 40-foot lengths up to 10-inch diameter for line-up and for backfill operations. In all cases their performance far exceeded expectations. Operators who formerly handled much larger sideboom tractors, remarked on the ease of operation and ability of the machines to do the work required.

"We consider these units to be a tremendous asset to our jobs because of their versatility and low operating and maintenance cost."

For further information on John Deere Crawler and Wheel-Type Tractors, see your nearest John Deere Industrial Dealer, or write to John Deere, Industrial Division, Moline, Ill.





The compact John Deere, with sideboom, maneuvers comfortably in a back lane on the Regina gas main job. It handles many jobs formerly done by hand or by larger, cumbersome tractors.

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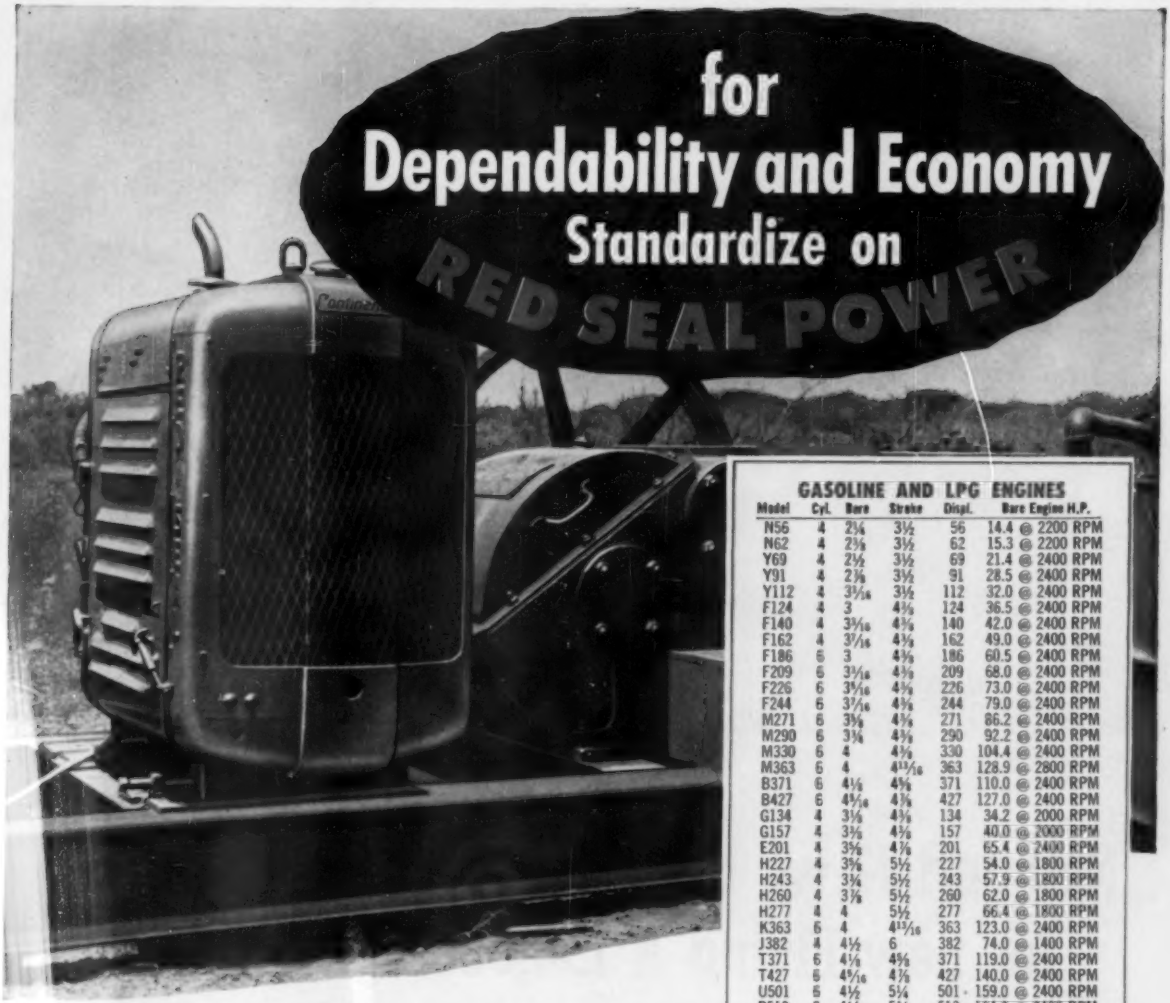

A product of more than 55 years' specialized experience, Continental Red Seal oil field power embodies an array of quality features—many of them exclusive—that make for dependability, economy and long trouble-free life. The Red Seal Model F-162 shown above, operating in Stonewall County, Texas, replaced another Red Seal which had been in pumping service continuously for eight years. . . . Red Seals are engineered for every oil field application. They are available at closely-spaced power levels, for use on all standard fuels. Ask your oil field supply store or get in touch with your nearest Continental office.

GASOLINE AND LPG ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N56	4	2¼	3½	56	14.4 @ 2200 RPM
N62	4	2⅜	3½	62	15.3 @ 2200 RPM
Y69	4	2½	3½	69	21.4 @ 2400 RPM
Y91	4	2⅞	3½	91	28.5 @ 2400 RPM
Y112	4	3 1/16	3½	112	32.0 @ 2400 RPM
F124	4	3	4⅛	124	36.5 @ 2400 RPM
F140	4	3 1/16	4⅛	140	42.0 @ 2400 RPM
F162	4	3 1/16	4⅛	162	49.0 @ 2400 RPM
F186	6	3	4⅛	186	60.5 @ 2400 RPM
F209	6	3 1/16	4⅛	209	68.0 @ 2400 RPM
F226	6	3 1/16	4⅛	226	73.0 @ 2400 RPM
F244	6	3 1/16	4⅛	244	79.0 @ 2400 RPM
M271	6	3⅜	4⅛	271	86.2 @ 2400 RPM
M290	6	3¼	4⅛	290	92.2 @ 2400 RPM
M330	6	4	4⅛	330	104.4 @ 2400 RPM
M363	6	4	4 13/16	363	128.9 @ 2800 RPM
B371	6	4½	4⅝	371	110.0 @ 2400 RPM
B427	6	4 1/16	4⅞	427	127.0 @ 2400 RPM
G134	4	3½	4⅛	134	34.2 @ 2000 RPM
G157	4	3½	4⅛	157	40.0 @ 2000 RPM
E201	4	3⅝	4⅞	201	65.4 @ 2400 RPM
H227	4	3⅞	5½	227	54.0 @ 1800 RPM
H243	4	3¼	5½	243	57.9 @ 1800 RPM
H260	4	3⅜	5½	260	62.0 @ 1800 RPM
H277	4	4	5½	277	66.4 @ 1800 RPM
K363	6	4	4 13/16	363	123.0 @ 2400 RPM
J382	4	4½	6	382	74.0 @ 1400 RPM
T371	6	4⅛	4⅝	371	119.0 @ 2400 RPM
T427	6	4 1/16	4⅞	427	140.0 @ 2400 RPM
U501	6	4½	5¼	501	159.0 @ 2400 RPM
R513	6	4½	5⅛	513	164.3 @ 2400 RPM
R572	6	4¾	5⅛	572	182.4 @ 2400 RPM
R602	6	4⅞	5⅛	602	191.7 @ 2400 RPM
V603	8	4¼	4¼	603	220.0 @ 2800 RPM
S749	6	5⅛	5½	749	217.0 @ 2200 RPM
S820	6	5⅛	5½	820	237.0 @ 2200 RPM

CUSHIONED POWER DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
ZD129	4	3¼	3⅞	129	34.0 @ 2000 RPM
GD157	4	3⅜	4½	157	39.0 @ 2000 RPM
*ED201	4	3⅝	4⅞	201	45.8 @ 2000 RPM
HD243	4	3¾	5½	243	55.0 @ 2000 RPM
*HD260	4	3⅞	5½	260	59.0 @ 2000 RPM
*HD277	4	4	5½	277	63.2 @ 2200 RPM
*JD382	4	4½	6	382	72.5 @ 1600 RPM
TD427	6	4 1/16	4⅞	427	106.0 @ 2000 RPM
RD572	6	4¾	5⅛	572	154.0 @ 2000 RPM
VD603	8	4¼	4¼	603	175.0 @ 2600 RPM
SD802	6	5 5/16	5½	802	202.0 @ 1800 RPM

*Available for industrial applications only.

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CONTINENTAL MOTORS ® Powerful as the Nation AMERICA'S STANDARD

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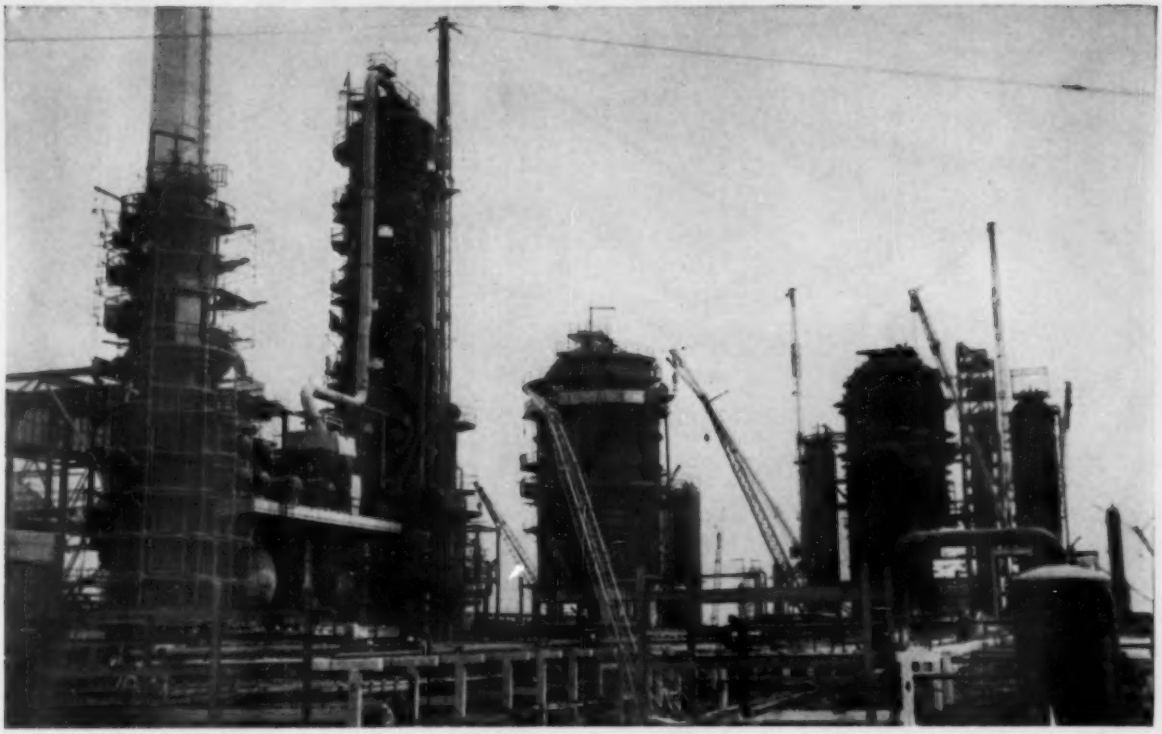

A dozen vessels built by Newport News were furnished under contract with C. F. Braun, Inc., of Alhambra, Calif., design engineers for the ultra-modern Delaware Flying A Refinery of the Tidewater Oil Company located 15 miles south of Wilmington.

Newport News builds 12 major components for new Flying A 130,000-bpd refinery

This is the Tidewater Delaware Flying A Refinery while under construction near Wilmington.

Newport News fabricated 12 of its major vessels — 2 of which are the largest such units ever built: a 250′ Orthoflow fluid "cat cracker" converter and a 225′ reactor scrubber of the fluid coker.

More notable than size, though, is the quality of the Newport News fabrication.

Coke-out screens in the reactor scrubber, for example, are made of 704 12% chromium segments. Welded together with accuracy, they provide 45% clear opening . . . with opening tolerances less than 1%.

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Full advantage was taken of the Newport News deep water loading facilities for transportation of all of the equipment by barge. Shop erection prior to shipment assured fast, trouble-free field assembly.

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Newport News Shipbuilding and Dry Dock Company, Newport News, Virginia

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4-WAY LEADERS OF THE LOW-PRICED 3

Now—for the first time in truck history—one make leads the low-priced three *all four ways!* And that make is DODGE—all new for 1958!

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See these great new trucks soon. And be *sure* to get your Dodge dealer's special 40th-anniversary deal before you buy any other make!

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2 **FIRST IN POWER!** New 204- to 234-hp. *Power Giant* V-8's! Extra power cuts trip time, lets you pass more safely, reduces engine strain.

3 **FIRST IN ECONOMY!** Most advanced of all V-8 truck engines. Exclusive Power-Dome combustion increases gas mileage, cuts upkeep costs.

4 **FIRST IN STYLING!** All-new design! Deluxe chrome grille and trim . . . modern dual headlights . . . future-inspired lines . . . smart new colors.

TURN PAGE FOR FULL-LINE STORY →

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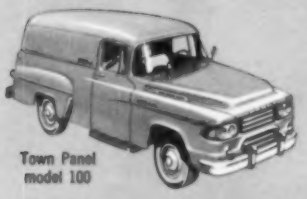
'58 DODGE PowerGiant

for every job . . . for every business . . . for every pocketbook

Low-tonnage models

Pick-up
model 100



Town Panel
model 100

Town Wagon
model 100

Forward-Control
model P300

Medium-tonnage models

Model 400
Van Body

Model 500—Stake

Four-Wheel-Drive
W500
Chassis

Model 600
Tractor

Heavy-duty models

C.O.E. model 700

Model 900—
Tractor

Model T800—
Mixer Body

Model T900—
Dump Body

CONDENSED SPECIFICATIONS

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G.V.W. Range
4,250 lbs. to 9,000 lbs.
Engines
120-hp. 6-cylinder
204-hp. V-8

4-WHEEL-DRIVE MODELS

G.V.W. Range
5,100 lbs. to 10,000 lbs.
Engines
113- 120- 125-hp. 6-cyl.
204-hp. V-8
204-hp. V-8 (Heavy-Duty)

FORWARD-CONTROL MODELS

G.V.W. Range
6,000 lbs. to 9,000 lbs.
Engines
120-hp. 6-cylinder
204-hp. V-8

CONVENTIONAL MODELS

G.V.W. Range—11,000 lbs. to 22,000 lbs.
Engines—125- 130- 141-hp. 6-cyl.
204- (H.D.) 207-hp. V-8's

C.O.E. MODELS

G.V.W. Range—15,000 lbs. to 22,000 lbs.
Engines—204- (H.D.) 207- 218-hp. V-8's

4-WHEEL-DRIVE MODELS

G.V.W. Range—15,000 lbs. to 20,000 lbs.
Engines—130-hp. 6-cylinder
204- (H.D.) 207-hp. V-8's

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Engines—125- 130- 141-hp. 6-cyls.
204- (H.D.) 207-hp. V-8's

FORWARD-CONTROL MODELS

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Engines—120-hp. 6-cylinder
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CONVENTIONAL MODELS

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Engines
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C.O.E. MODELS

G.V.W. Range
18,500 lbs. to 25,000 lbs.
Engines
218-hp. V-8

TANDEM MODELS

G.V.W. Range
26,000 lbs. to 46,000 lbs.
Engines
218- 224- 234-hp. V-8's

SCHOOL BUS MODELS

G.V.W. Range
17,500 to 23,000 lbs.
Engines
218-hp. V-8

if you refine oil... and answer
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PROBLEM	TRETOLITE PRODUCT	APPLICATION
Salty Crude	Tretolite Desalting	Crude Charge
Corrosion	Kontol Corrosion Inhibitors	Internal Piping, Refinery Equipment
Tank Bottoms	Tretolite Demulsifiers	Storage Tank Settlings
Waste Oil	Tretolite Water De-Oilers	Waste Oil Separators
Product Emulsions	Tretolite Fuel Emulsion Preventives	Burning Oils and Diesel Fuels
Copper Contamination	Kuplex Metal Deactivator	Gasoline, Kerosene, Jet Fuel, Diesel Oil, Burning Oil

The Tretolite Company Refinery Service Department is always available to assist you in any refinery problem. There is no charge or obligation for consultation or advisory service. Just ask your Tretolite Refinery Service Engineer...

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Campbell Chain

GOES BIG WITH ANY RIG!

"Measure-Mark" Chain

CAM-ALLOY and CAMPBELL HIGH TEST STEEL

Exactly marked every 5'. Color-coded for instant grade identification. Standard footage in every pack—color-coded labels with inventory control. **Cam-Alloy** features *extremely* high tensile strength—excellent resistance to wear—light weight for given load. Look for the *orange* "Measure-Mark." Campbell **High Test** Steel Chain is high-carbon steel, heat-treated for high tensile strength and maximum resistance to abrasion. Short links give maximum flexibility. Look for the *blue* "Measure-Mark."

BOOMER CHAINS

Made from Cam-Alloy or High Test Steel Chain with Grab Hook each end, 20 feet long. Supplied bright finish. Packed one chain in cloth bag. In dimensions and weights for every job.

WINCH LINE CHAINS

Made from High Test Steel Chain, heat-treated for increased resistance to wear and shock loads. Tagged for size and length. Bright finish. In dimensions and weights for every job.

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Available in 3 grades: *Lug-Reinforced* for maximum traction and wear, *Mud-Service* for off-the-road use, *Highway Service* for general use . . . single pneumatic and dual triple.

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TERRITORY MANAGERS: J. N. Kuhl, 7000 S. Shore Drive Hotel, Chicago, Ill.; S. Hardison, 1970 Val Verde, Germantown, Tennessee; S. Adsit, 17 E. 57th St., Kansas City, Mo.; A. E. Vincent, 3917 Thaxton Ave., S.E., Albuquerque, N. Mex.; K. Steinmetz, 1339 Sherwood Road, Glenview, Ill.; D. A. Ruffin, 5623 Boaz St.—Apt. #90, Dallas 9, Texas; G. W. Ferree, 5634 Putnam Drive, Birmingham, Mich.

CONTACT ANY OF THE CAMPBELL REPRESENTATIVES ABOVE FOR COMPLETE INFORMATION ON *ANY* TYPE OF CHAIN—OR HELP WITH A PARTICULAR CHAIN PROBLEM.

They Say—

Could we face second Suez?

Dear Sir:

Assuming that the communists are able to shut off the supply of Arabian oil, is the free world as dependent on that today as it was a year ago?

Of course, it is a great factor—but I mean is not the Western Hemisphere in a better position today to supply more crude petroleum and have better transportation facilities than it was a year ago . . . in the event of, say, political subversion by the communists that would give them control of Arabian oil? And won't the Western Hemisphere be in a better position a year from now than it is today to meet that calamity with both transportation facilities and crude?

Alf M. Landon
Topeka, Kans.

Safety in the company plane

Dear Sir:

After reading the October 28 issue of The Oil and Gas Journal, page 68, ("Oil Men Want Their Planes Improved") I would like to give you a pilot's unbiased opinion . . .

About safety—Just because (the pilot) has thousands of hours logged flying time and many, many hours of instrument flying doesn't mean he is competent. It all depends on recent practice. Most executive aircraft average about 300 hours per year. Maybe it has been 6 or 8 months since the pilot has had an instrument flight. Suddenly you call him up for an unexpected trip and the weather stinks along the route. If he wants to keep his job he will argue the trip and sug- his job he will not argue the trip and suggest you take a commercial, and,

How many of the large companies have Link trainers for simulated instrument training, or require their pilots to practice instrument flying with a safety pilot occupying the co-pilot seat? A pilot must have a minimum of 10 hours instrument practice each 6 months to remain competent to file a flight plan and be reasonably sure of getting you there safely. I feel qualified to make this statement as I have 17 years of teaching instrument flying.

There is nothing I would like more right now than to have a job as a pilot in a nice plush aircraft but with the understanding that I could say at any time that the weather demands

engineered corrosion control with *Cronox*® inhibitors

The pay-off of corrosion control . . . in preventing loss of production and prolonging equipment life . . . depends on how thoroughly the job is engineered.

And thorough engineering is what you are sure of getting from Aquaness. First, because your Aquaness representative's experience has been gained where it counts . . . in the field. He is familiar with the corrosion problems of all types of wells . . . flowing, gas-lift, gas-condensate, pumping or water flood.

Second, because there is a Cronox inhibitor for every application . . . vapor phase, sticks and concentrated . . . bactericides and bactericide-inhibitors. From these your Aquaness representative can make exact recommendations for your wells.

Get your engineered corrosion control program started today, by calling your local Aquaness representative.

New booklet! "CRONOX Corrosion Inhibitors."
Write for your free copy.

Aquaness Department
ATLAS POWDER COMPANY
2005 Quitman Street, Houston 26, Texas

No. 6 advertisement of six proving . . .

why Jones sucker rods last longer

1. *Advanced Research and Development*
2. *Advanced Engineering Experimentation and Control*
3. *Advanced Metallurgy and Heat Treating*
4. *Advanced Manufacturing and Production*
5. *Advanced Inspection and Testing Techniques*
6. ✔ *Advanced Field Engineering and Service*

There is a

TYPE 7

JONES

ALLOY SUCKER RODS

The standard of quality of many leading companies for medium to heavy pumping under all conditions.

Made of nickel molybdenum steel, fully normalized, tempered, descaled and shot peened to gain further fatigue and corrosion resistance.

For longer life, specify Jones Sucker Rods.

The S. M. Jones Company ADVANCED FIELD ENGINEERING AND SERVICE

To serve an oil producing man well, it is necessary to know his problems and to have the practical and technical knowledge necessary to help solve them.

The S. M. Jones Company was first and foremost in field engineering and well studies. It organized in 1935 an engineering department to learn all possible about the mechanics of sucker rod pumping. One of the principal methods used to attain this end was the development and manufacture of a well weigher, or dynamometer. This instrument, when installed on the polished rod on a pumping well, gives a permanent record of all the operating characteristics. Subsequent analysis and tabulation of the data obtained brought to the entire oil industry invaluable information on the proper application of pumping equipment, and in particular, sucker rods.

It is hard to beat this combination of good technical service and a superior sucker rod developed and proven by S. M. Jones' 65 years of experience. Use this combination to avoid trouble, save time . . . and as a consequence, save money.

6070

Oil companies having difficult pumping problems often ask us for help in solving them. Our field engineers make a careful study of the problem. When necessary, an engineer goes to the field and checks the troublesome well. Suggestions are then made for correction and improvement of rod service. District representatives of the S. M. Jones Company are available to arrange well tests whenever pumping problems arise.

THE S. M. JONES COMPANY

Division of Buffalo-Eclipse Corporation

General Office and Factory: **TOLEDO, OHIO**
Sales Office: Enterprise Building, **TULSA, OKLAHOMA**
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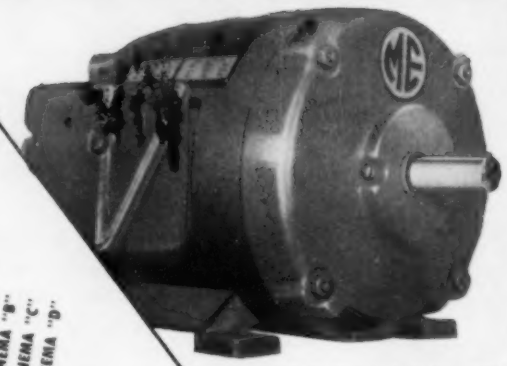
MOTORS — GENERATORS
OILFIELD MOTORS



New NEMA Frames 182 thru 326U

MARATHON ELECTRIC
Specifications:
40° C Rise Continuous Duty
Designs:
NEMA "B"
NEMA "C"
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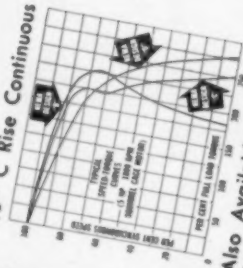

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● EXPERIENCE . . . PROVEN PERFORMANCE. There is no substitute for the reliability of proven performance . . . Top Names of the Nation's Industry have proven ME performance in PRODUCING QUALITY PRODUCTS.

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1/2 KW thru
2000 KW

Yours for the Asking

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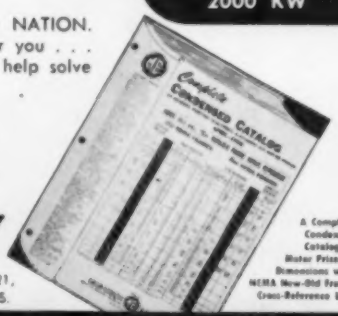
WAUSAU, WIS.



A Complete Condensed Catalog of Motor Prices & Dimensions with NEMA New-Old Frame Cross-Reference List.

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HOME OFFICE AND FACTORY, WAUSAU, WIS.
FACTORIES AT ERIE, PA. AND EARLVILLE, ILL.
SALES OFFICES IN PRINCIPAL CITIES

more than I could safely do. When the weather is below minimums for contact flight, buy a ticket on the commercial . . . One other important thing. Don't hire a pilot that has to get his job through pull. There are many qualified pilots that have years of experience available.

J. J. Leazenby
Hondo, Tex.

Photos tell wrong story

Dear Sir:

On page 132 of the October 21 issue of The Oil and Gas Journal you printed an article concerning the viscosity of lubricating oils. In the article you limit yourself to the discussion of Saybolt viscosity.

This is fine, but I cannot comprehend why you would label the photographs which are a part of the article as "Testing Saybolt Universal viscosity." In both photographs the technician is working with Kinematic viscosity apparatus.

Although both tests basically measure the same property of a lubricating oil by the same principle, the two tests are different in the apparatus used, the general procedure of the tests themselves, and in the units of measure.

J. A. Detterick
Petersburg, Va.

Editor's Note: We are aware of the difference between these two tests. Somewhere between the editor's pencil and the press room someone apparently thought the type of apparatus shown should conform to the text. Originally, the photographs were identified as the Kinematic viscosity type.

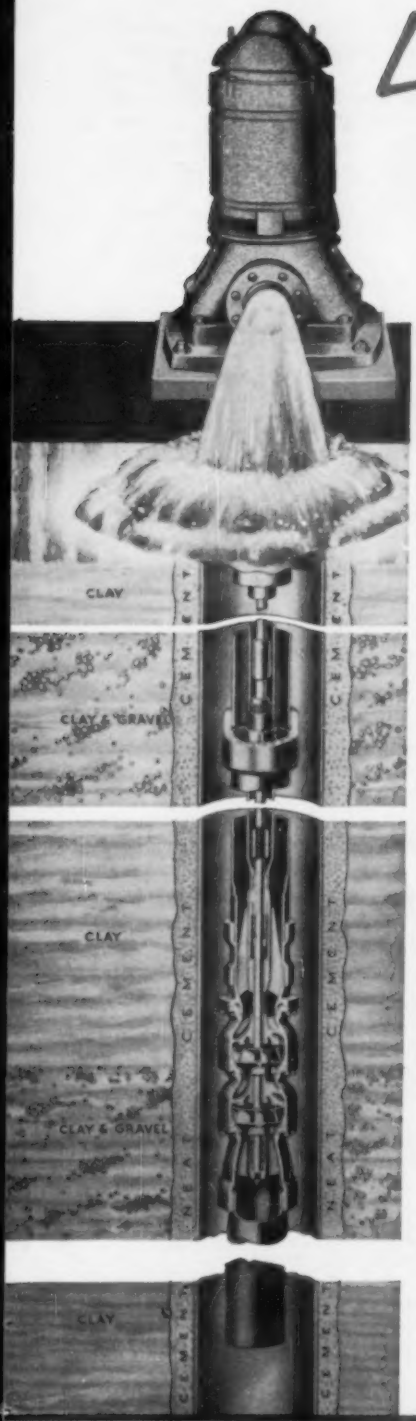
No coal votes for gas bill

"Invasion of coal's traditional markets by natural gas and imported crude and residual oils stemming from existing competitive advantages, has had an adverse impact on coal's economic position. A continuation of the trend will further the economic squeeze and place the nation's total energy supplies in jeopardy. It should be apparent, therefore, why the coal industry will fight for its place in the energy market and will resist those things that would impair its capacity to serve the nation.

"Let me make it clear, the coal industry does not seek special advantage, nor does it want to impose handicaps on gas and oil that would interfere with fair competition. We seek only to preserve our own rightful place in the energy market.

"Some of the factors contributing

Layne knows more about water bearing formations!



On whose say-so? Not on ours—but on the experience of scores of American and foreign firms and municipalities whose very existence and success depend on an adequate supply of water.

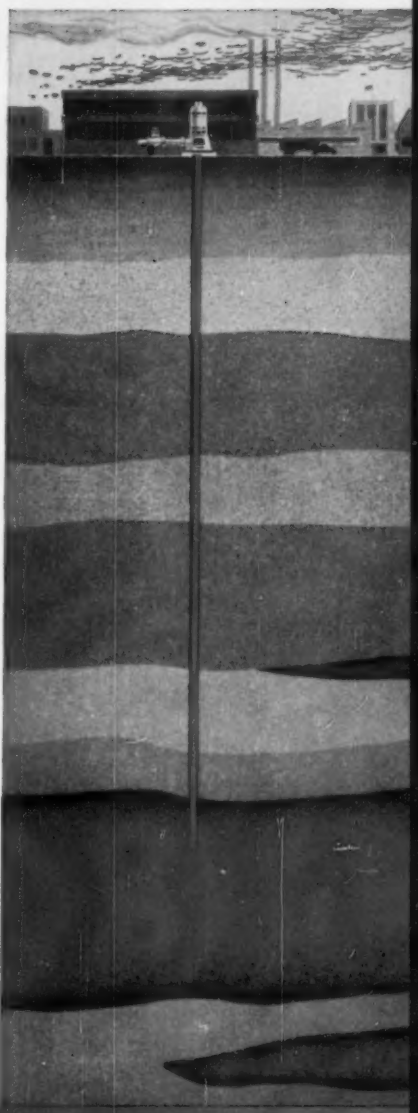
Knowing where the water is—and then tapping the subterranean source is but a part of the vast knowledge the Layne organizations have accumulated in three quarters of a century.

Once the source is determined and the water supply developed, a dependable means for delivering the water must be provided, and that's where the famous Layne pump comes in. For each Layne pump is specifically engineered for the particular job. There is no "stock" Layne pump. Your pump is created for your job—making use of the knowledge of strata, water requirements and usage.

ENGINEERED, DEPENDABLE PERFORMANCE IS WHAT YOU GET WHEN LAYNE DOES THE JOB—COMPLETE FROM WATER LOCATION TO YEAR AFTER YEAR OF TROUBLE-FREE PUMPING.

YOUR NEXT WELL AND PUMP INSTALLATION MAY BE MONTHS OFF. GET TO KNOW THE LAYNE FOLKS IN YOUR AREA. SAVE TIME AND MONEY THROUGH THEIR INTIMATE KNOWLEDGE OF WATER.

Send now for our general services bulletin No. 100.



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So remember, there's more in that familiar green truck than meets the eye . . . the skilled crew, the engineer, the equipment engineered by experts! *Your reasons* to have Elgen in *your well logging picture!*

Elgen offices are located in major oil areas . . . call or write today for complete information on Elgen well logging advantages.

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2925 MERRELL ROAD / DALLAS, TEXAS
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materially to coal's loss of position in the competitive energy markets arise from imperfections in the Natural Gas Act . . . The Harris bill does not attempt to solve any of these problems. So far as that bill is concerned, it would compound our difficulties."

Tom Pickett, executive vice president, National Coal Association, in a speech to the Independent Petroleum Association of America.

Atom vs. oil: room for both

"A nuclear reactor requires bulky and heavy shielding in order to protect people in the neighborhood from harmful radiation during the operation of the machine. This is not practical in small mobile units.

"No matter how inexpensive fuels become, oil will retain a most important role in rapid and independent engines of transportation. This emphasizes the importance of conservative practices with respect to our oil supplies because there are some applications of energy where no substitute for oil fuel is in sight."

Dr. Edward Teller, professor of physics and associate director of the radiation laboratory, University of California, in an article in the fall issue of The Lamp, magazine of Standard Oil Co. (N.J.)

Competition isn't painless

"Although the antitrust law is designed to promote competition in business, some of the greatest difficulties arise from the possibility that it may actually contribute to put business in a strait jacket and stifle competition.

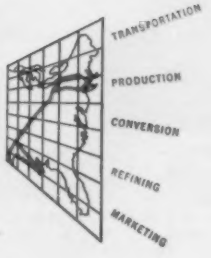
"This paradox has been at the root of the embittered controversy which has continued for years over the so-called good-faith defense. This defense is supposed to permit a company to make selective price reductions acting in 'good faith' to meet a competitor's lower price. The controversy . . . is now heading to a new climax because the U. S. Supreme Court has consented to pass on the key Standard Oil of Indiana case for the second time. . .

"The earlier decision . . . should have settled the question of whether a company can reduce its price selectively—without doing so all along the line—even though such a reduction might involve some competitive injury. The Supreme Court held that the defense was 'absolute,' the fact that it involved some competitive injury notwithstanding. . .

"Competition is not a painless process. It is hard to conceive of

8 foot 5... and they call him "TINY"!

Sometimes, names are confusing. Ours, for example, is "Tennessee Gas". But our pipeline begins in Texas... reaches to New Hampshire. Tennessee is only *one* of the 15 states served by our 9800 mile system. We're the nation's longest pipeline but we're in the oil business, too. We explore for and produce gas and oil from the Gulf to Canada... extract and convert their hydrocarbons... refine and market petroleum products. With our expanding activities, we cover a lot of ground. More than you'd think from our name.



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HOUSTON, TEXAS

for safer connections

join pipe

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You'll find many piping jobs in and around oil terminals and refineries that can be simplified and speeded up with Dresser Couplings and Long Sleeves.

Particularly advantageous for tank and equipment installations, Dresser Couplings have a special "built-in" give and take that absorbs vibration, settlement and other stresses.

Perfect alignment of piping is unnecessary because a specially compounded rubber gasket permits up to 4° deflection at joints while guaranteeing bottle-tight connections.

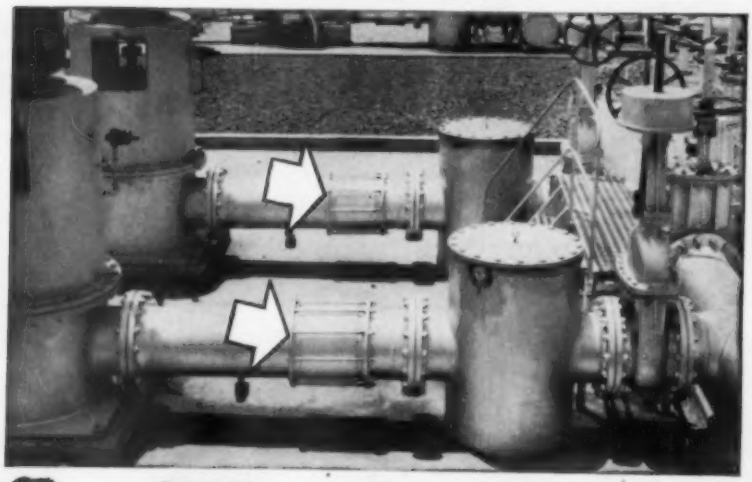
Only a wrench is needed to make the connection. Threading is not required. Any workman can install Dresser Couplings, averaging two man-minutes per bolt.

AVAILABLE AT ALL LEADING OILFIELD SUPPLY STORES IN THE UNITED STATES AND CANADA

DRESSER®

Dresser Manufacturing Division • Bradford, Pa.

Dresser 10" Style 40 Long Sleeves on pump at oil terminal



Style 38 Coupling

Style 40 Long Sleeve

Hydrepair® Asbestos Cement Pipe Clamp

Style 63 Expansion Joint

Style 39 Insulating Coupling

any situation involving any kind of price reduction on any scale which will not have an adverse effect on somebody selling something else.

"It is hard to believe, however, that the good-faith proviso was meant to imply that a company should be forced to suffer substantial injury and loss as a result of its pricing policies just to avoid injury to somebody else."

Editorial in the New York Journal of Commerce.

CALENDAR

NOVEMBER

18 Independent Producers and Royalty Owners Association of New Mexico, first annual convention, Alvardo Hotel, Albuquerque, N. M.

18-19 Chemical Institute of Canada, divisional meeting, analytical chemistry subject division, Sheraton Brock Hotel, Niagara Falls, Ont.

22 Natural Gasoline Association of America, Panhandle Plains regional meeting, Herring Hotel, Amarillo, Tex.

26-28 New Mexico Oil and Gas Association, annual meeting, La Fonda Hotel, Santa Fe.

DECEMBER

1-3 Interstate Oil Compact Commission, annual meeting, Tulsa.

1-3 Kansas Independent Oil and Gas Association, twentieth annual meeting and oil show, Broadview Hotel, Wichita, Kans.

1-6 American Society of Mechanical Engineers, annual meeting, Statler Hotel, New York.

2-6 Twenty-sixth Exposition of Chemical Industries, Coliseum, New York.

8-11 American Institute of Chemical Engineers, annual meeting, Conrad Hilton Hotel, Chicago.

10-11 University of Oklahoma, second annual conference on water quality control for subsurface injection, sponsored by the School of Petroleum Engineering, Extension Study Center, Norman, Okla.

JANUARY

11-12 National Oil Scouts and Landmen's Association, directors' meeting, Adolphus Hotel, Dallas.

16-18 Association of Oilwell Servicing Contractors, second annual convention, Baker Hotel, Dallas.

19-22 Pipe Line Contractors Association, tenth annual convention, Boca Raton Hotel and Club, Boca Raton, Fla.

31 Natural Gasoline Association of America, regional meeting, Skirvin Hotel, Oklahoma City.

FEBRUARY

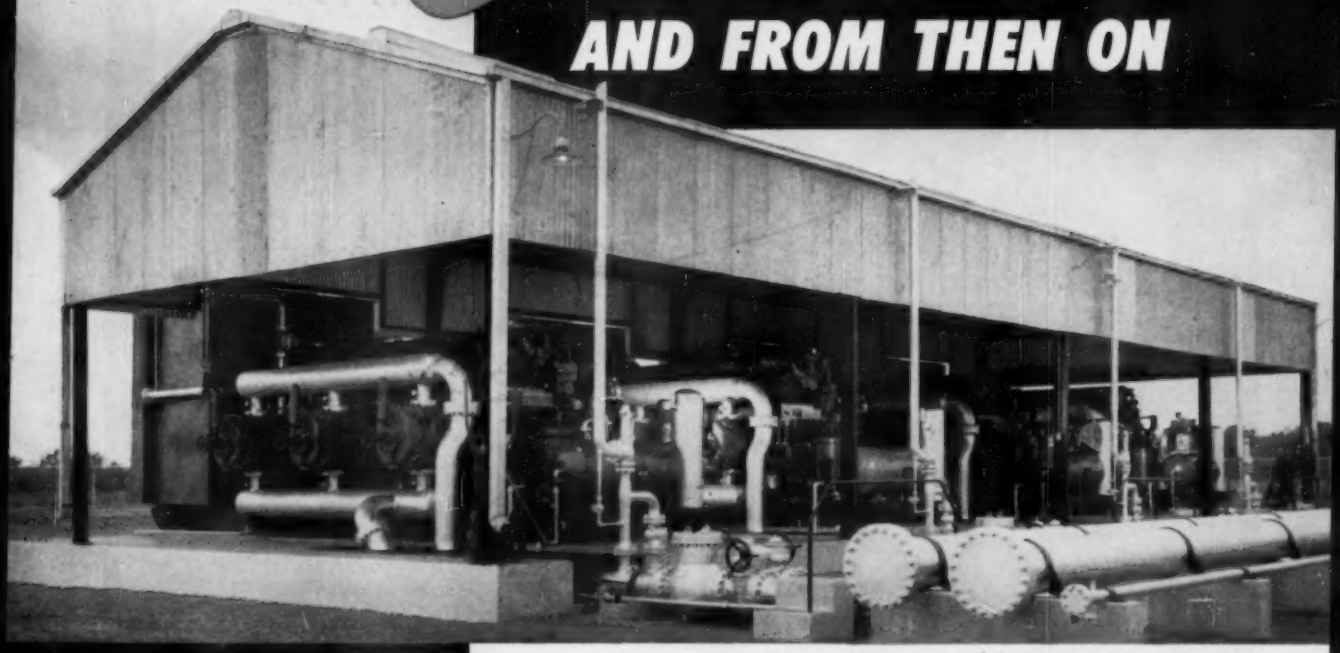
12-14 National Association of Corrosion Engineers, Tulsa section, ninth annual corrosion short course for pipeliners, Mayo Hotel, Tulsa.

16-20 American Institute of Mining, Metallurgical, and Petroleum Engineers, annual meeting, Hotel Statler, New York.

26-28 American Petroleum Institute, Division of Production, southern district meeting, Shamrock-Hilton Hotel, Houston.

28 Natural Gasoline Association of America, Permian basin regional meeting, Lincoln Hotel, Odessa, Tex.

Save ON FIRST COSTS AND FROM THEN ON



Industrial Gas Supply Corporation, Needville, Texas, Compressor Station.

Southwest packaged gas compressors for main line stations

Illustrated above is an installation of four 660 hp Southwest-Cooper Bessemer GMXD-10 Packaged Compressors, handling Industrial Gas' total line capacity of 100 MMCF/D.

Southwest Packaged Gas Compressors for main line compression are **being** installed for **less than $200 per horsepower.** And they will be running months before field assembled units can be built!

Lower first costs are only part of the story. Unattended operation, possible with the automatic controls and safety devices on Southwest Packaged Compressor Plants, cuts operating cost per horsepower-hour to a fraction of the cost of a fully attended installation.

The final economy for your pipeline is that this station never need be shut down completely. In South Louisiana, the capacity of a main line station with eight 660 hp Southwest units, is reduced only 12½ per cent when one unit is down. However, if two 2600 hp units were used instead, capacity would be reduced 50 per cent when one unit is down.

These are all proved facts. Southwest engineers can show you **the results** and savings pipelines are realizing now with Southwest Packaged Gas Compressors.

FOR GAS LIFT, GAS BOOSTER, PRESSURE MAINTENANCE AND SIMILAR PROJECTS.

SOUTHWEST INDUSTRIES, INC.

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Odessa, Texas	Casper, Wyo.
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During the drilling and completion operations on every well, there comes a time when good service from your equipment supplier can save you money.

O-C-T has earned its reputation for good service by dependable performance in the field year after year.

We can only guess how many thousands of dollars have been saved for the oil industry by prompt O-C-T service. But we do know this: Oil Center Tool Company maintains the largest service organization in the field to help you set and service wellhead assemblies.

It makes a good combination you can count on . . . the most dependable equipment plus the best service in the field.

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MARCH

3-4 Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, fourth annual joint meeting of Rocky Mountain petroleum sections, Cosmopolitan Hotel, Denver.

5-6 Gas Conditioning conference, sponsored by the University of Oklahoma, Oklahoma Memorial Union Building, Norman, Okla.

7 Ohio Oil and Gas Association, winter meeting, Deshler Hilton Hotel, Columbus, Ohio.

10-13 American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, forty-third annual meeting, Biltmore Hotel, Los Angeles.

12-14 American Petroleum Institute, Division of Production, southwestern district meeting, Hotel Texas, Fort Worth

17-21 International Atomic Exposition, Inc., 1958 Nuclear Congress, Chicago Amphitheatre, Chicago.

17-21 National Association of Corrosion Engineers, annual conference, civic auditorium, San Francisco.

20-21 Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, regional conference on production and reservoir engineering, Mayo Hotel, Tulsa.

24-26 Midwest Gas Association, Broadmoor Hotel, Colorado Springs, Colo.

31-April 2 American Petroleum Institute, Division of Transportation, annual pipeline conference, Jung Hotel, New Orleans.

APRIL

1-3 University of Oklahoma, fifth annual conference on corrosion control, Extension Study Center, Norman, Okla.

9-11 American Petroleum Institute, Division of Production, Mid-Continent district meeting, Biltmore Hotel, Oklahoma City.

15-17 University of Oklahoma, thirty-fourth annual gas measurement short course, North Campus, Norman, Okla.

16-18 Natural Gasoline Association of America, annual convention, Baker and Adolphus Hotels, Dallas.

17-18 American Institute of Mining, Metallurgical, and Petroleum Engineers, Louisiana-Arkansas, East Texas, and Mississippi petroleum sections, gas technology symposium, Shreveport, La.

20-23 American Institute of Chemical Engineers and Chemical Institute of Canada, chemical engineering division; Canada-U.S. chemical engineering conference, Montreal.

21-23 American Petroleum Institute, Division of Production, Rocky Mountain district meeting, Cosmopolitan Hotel, Denver.

27-29 Independent Petroleum Association of America, midyear meeting, Hotel Sherman, Chicago.

27-30 American Association of Petroleum Geologists, Rocky Mountain section, Casper, Wyo.

28-29 University of Oklahoma, third annual conference on automatic control in the petroleum and chemical industries, Oklahoma Memorial Union Building, Norman, Okla.

MAY

5-6 Society of Petroleum Engineers of A.I.M.E., North Texas section, secondary-recovery symposium, Wichita Falls, Tex.

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Famous old "999" scorched the rails at 112 mph in 1893
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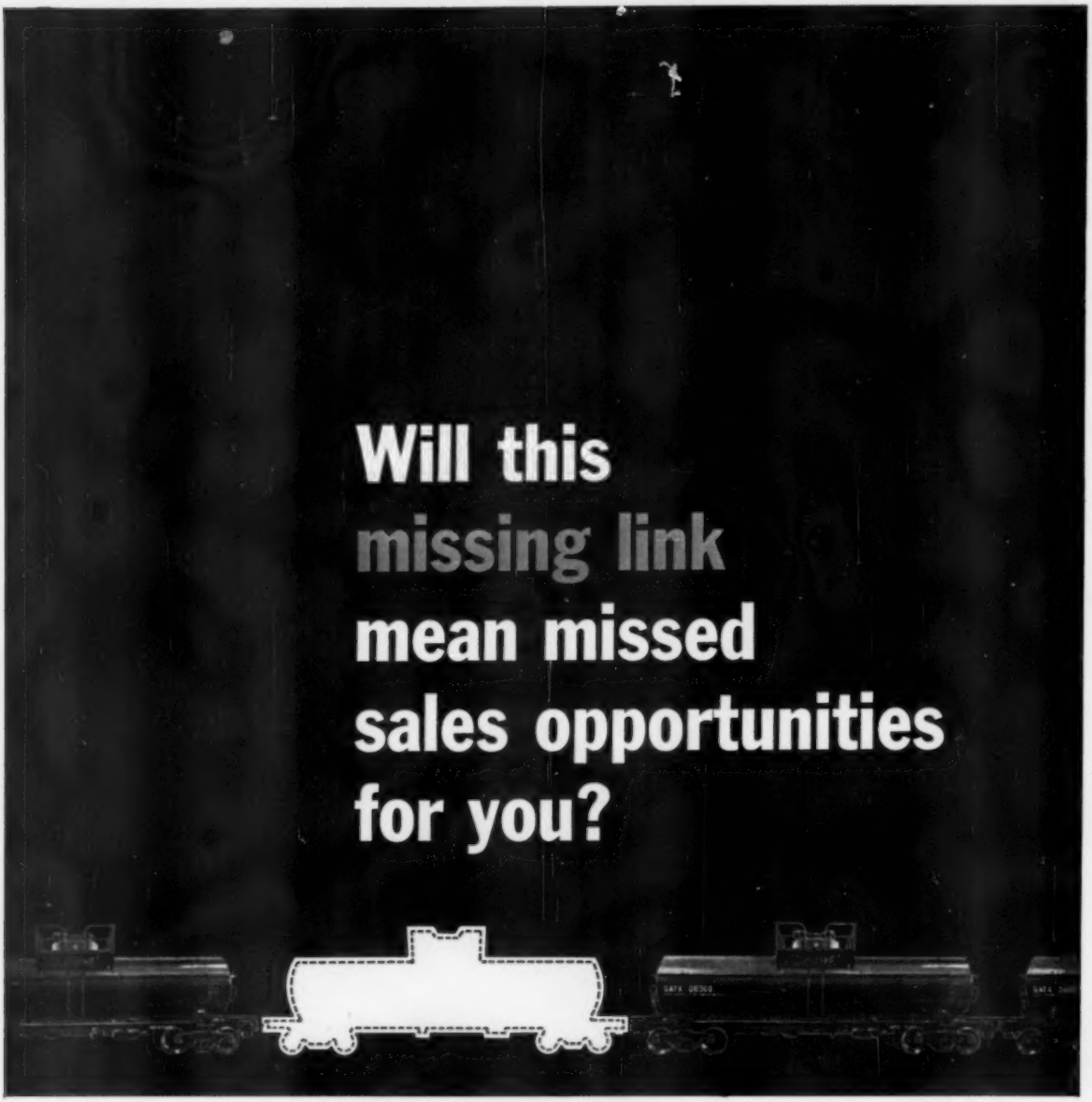

You'll want every general-purpose tank car you can lay your hands on in the decade ahead. Forecasts point to booming production and sales, and a vastly increased demand for shipping facilities. But normal obsolescence affects tank cars, too. A shortage of steel, plus the time required to build, will make for scarcity. That's why alert businessmen are already examining transportation requirements—planning for tomorrow's markets . . . today.

P. S. Plan now to discuss your long-range needs with our GATX District Man. You'll find . . . it pays to plan with General American.

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TULSA, OKLAHOMA

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JOURNALLY SPEAKING

The Compleat Conventioner

LAST WEEK at the big A.P.I. meeting in Chicago we completed a research project we have been working on for several years: How to get the most out of a convention.

After scientifically coordinating and evaluating data painstakingly gathered at scores of industry meetings, we have reached the conclusion that too many oil men fail to take the fullest advantage of the opportunities afforded at conventions.

Their attitude is wrong — entirely out of keeping with the best traditions of the industry. They don't show the gambling spirit, the desire to take risks, the confidence in their ability to capitalize on the unexpected, and the other things that have made this industry great.

That way they miss most of the fun which is, of course, the main reason for going to a convention.

So we have made up a set of rules for proper conventioneering. These rules are based on actual case studies and have been field-tested and checked for reliability.

Follow these simple rules and you'll find conventions much more rewarding:

1. Don't make reservations in advance. There's always a chance that you won't get there, and tying up rooms discourages other people from attending. You can always put the screws on somebody on the local arrangements committee to get you a good room after you arrive.

2. Don't make the mistake of planning what you are going to do at the meeting. The unexpected always happens, and it's much better to just do what comes naturally after you get there instead of being inhibited by a preconceived schedule.

3. Don't make advance appointments with other men you want to see at the meeting. They might not keep them, and besides, you may run into something you'd rather do at that time. You'll probably be able to buttonhole your man in the lobby, anyway.

4. Don't check the program to see what speeches and reports you ought to hear. Somebody is sure to invite you to have a drink at that time and it would spoil your enjoyment to know what you are missing.

5. Don't go to committee meetings. The only people who attend are serious-minded squares who never have any fun. The chairman will make all the decisions and write the report himself, anyway.

6. Don't check the registration list to see who's there that you ought to look up. Put a copy in your pocket and read it when you get home. It's lots of fun to discover how many people you didn't see there and to wonder where they kept themselves.

7. Stick with your old friends, particularly those from your own company or home town. That way you won't run the risk of being bored by strangers.

8. Don't fraternize with your competitors. In a weak moment you might let slip a bit of information that would do the other guy some good.

9. Don't waste your time in the general sessions. The chairs are hard and the speakers might be boring, and you just can't get the relaxation you came for.

10. Don't make notes of things you want to discuss with other conventioneers. It spoils the conviviality of the occasion to start talking business. Just tell funny stories, and sooner or later the other fellow may bring the conversation around to the subject you had in mind before you left home.

11. Leave your diet and inhibitions at home. Take advantage of every opportunity to eat, drink, and indulge yourself. This is very relaxing and makes you willing to put up with your humdrum routine when you get back.

12. Never take your wife to a meeting. She will keep you from going out with the boys at night, make you leave the bar in time for the banquet, and just generally louse up your opportunities to get the most out of a convention.

—Henry D. Ralph.

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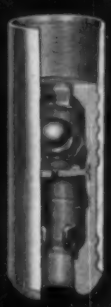
This is the Baker DIFFERENTIAL Fill-Up Shoe (Product No. 1081) which permits the casing to fill automatically from the bottom while it is being run. A variable valve opens to relieve destructive high pressure surges, and closes to regulate casing fill. Ask for Catalog Supplement No. 301, describing DIFFERENTIAL Fill-Up Equipment.



This is the new Baker FLEXIFLOW Fill-Up Shoe (Product No. 160). Permits casing to fill from the bottom through a hole in a flexible diaphragm that opens up to relieve dangerous high pressure surges, and closes down to control casing fill. Cuts casing running time by as much as one-third. Ask for Catalog Supplement No. 325.

This is the Baker Cement GUIDE Shoe usually run in combination with Baker FILL-UP Collars, or Float Collars when one back pressure valve is considered sufficient. Safely guides casing to bottom. Specify Product No. 102.

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A chewing out and a plan for action

THAT speech by Charlton Lyons at the API deserves attention from everyone in the oil industry.

It was noteworthy on several counts. It was direct, specific, hard-hitting, analytical and constructive. The words came from a man who has been on the inside of all the things he talked about.

No critic outside the industry has ever condemned the sins of oil men more severely. But Lyons had chapter and verse. There were no vague generalities, no mild chiding.

He specified wherein the industry has been at fault in its public and governmental relations, documented his accusations, and detailed the remedies.

THIS WAS MUCH NEEDED. The industry's public performance during the past couple of years clearly shows that it needs to have some heads knocked together, needs to be rudely kicked out of its old habits of thinking and manners of acting.

Lyons said things that many in the industry have been groping toward, hinting at, not dared to say out loud. It was a rare example of constructive self-criticism.

An independent producer himself, Lyons unflinchingly blamed independent producers for the defeat of the gas bill they need so badly. He categorically accused independents of spreading false charges of the industry's oil lift for Europe.

Himself one who has spent much time in Washington fighting the industry's battles, Lyons ridiculed the industry's attempt to do this job by "a revolving group of amateurs."

But he didn't stop at listing the industry's failures. Others have done that, though seldom so effectively. Lyons went on to spell out in detail exactly what must be done in four different areas of public affairs.

His program makes sense: Build industry solidarity by making internal controversy objective and constructive; shift the emphasis of the public-relations program to answer the public's questions about the industry; conduct centralized economic research to make facts available; maintain a strong Washington office.

IT'S STRAIGHT THINKING like this that alone can save this industry from unfair attacks and repressive legislation. We need more of this kind of talk—and action based on it.

Now maybe we will get action. The mood of the industry today is for doing something drastic about its public relations.

Did Lyons crystallize this mood, or is he a voice crying in the wilderness? The answer will come in what the API and other industry leaders do in the next few months.

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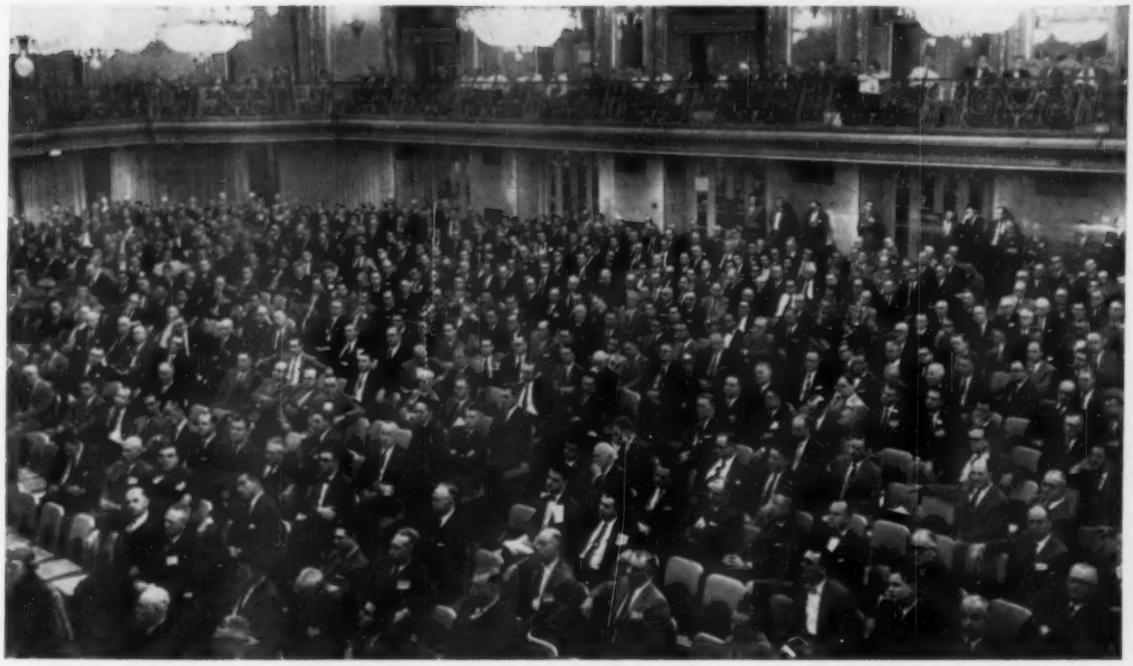


OPENING API GENERAL SESSION drew a near-capacity audience of oil men into the Conrad Hilton grand ballroom.

Year Ahead May Be Tough For Oil

That general warning emerged from Chicago API sessions where oil men learned there's plenty wrong with their business. Oil leaders aren't whimpering, however. They apparently are putting on their fighting clothes to meet the challenge.

A NEAR-RECORD API turnout reflected one symptom of the oil industry these days: A determination to talk things over and find the answers to perplexing problems.

Registration reached 6,455, only 25 short of the 1954 record. Last year's sessions attracted 6,388.

General tone of the well attended gatherings last week certainly couldn't be called optimistic. Neither was it one of complacency or sufferance, or sweating out a bad situation.

Rather the tone was one of tightening belts, putting on work clothes, and taking new approaches.

The outlook . . . This attitude was apparent in the treatment of—and the reaction to—the two main topics of API discussion: The business outlook and the political outlook.

Neither outlook is good, but neither one is hopeless.

Business is going to be poor next year.

There seemed little disagreement on this. Poor, that is, beside the optimistic expectations of a few months ago, but really not bad compared with the oil demand of a couple of years ago.

To offset this, the industry was told to turn to internal problems. It got a wide variety of advice on how to cut costs, improve efficiency, and do a better job of planning in times like these.

The political outlook is just as grim.

Oil is still in the public's doghouse, still the easy target of political demagogs, still faced with persecuting investigation and restrictive legislation.

To offset this, the API prepared to fight, and to fight with new and better weapons.

A new department of public affairs is being forged to absorb and reorient the old Oil Information Committee,

the American Petroleum Industries Committee, and perhaps other public-relations, educational, economic research, and legislative activities.

A Washington office, at long last, is going to be staffed to keep the industry in closer touch with the Government—and vice versa.

Individual oil men are going to become more active in public affairs—delivering speeches, testifying before committees, making friends and influencing people.

At least some of the bickering and disunity within the industry is going to be quelled. The API is going to try to get the various segments of the industry to understand each other as a prerequisite to getting the public to understand them all.

What oil men heard . . . If any oil man didn't know it already, he got the word at this meeting that the business boom is over. Exports from within and without the industry spelled this out with figures and charts. They said:

. . . We are in for a business recession in 1958.

Whether the dip will be mild or sharp, long or short, will depend on the interplay of a number of known but unpredictable factors.

. . . But it won't be a major depression.

Things probably will get worse before they get better, but there are plenty of reasons to count on a rebound.

Meanwhile there are certain maladjustments in the business structure that need correcting. Some of these are in the oil industry. When they are taken care of, the base will be laid for a new surge of a dynamic economy.

. . . Demand for all domestic products next year will be up 2.6 per cent.

. . . Oil will stay in oversupply.

Like many other industries, the oil industry was overly optimistic in its expansion plans. Now it will have to go on a diet and watch its calories—and its costs.

Among other things, oil operators should tighten their internal operations, do better long-range planning, and make better use of available economic information, mechanize operations, adapt personnel to the age of mechanization, improve budget and control methods, continue research on new products and more efficient methods.

. . . The imports problem may be settled.

At least, the API was told in no uncertain terms that the administration will accept no substitute for its present program and that imports will be held close to the forecast level. If this is unsatisfactory to both importers and domestic producers, there was general acceptance of it as a fact—for the coming few months, anyway.

Gold medal winners congratulate each other. Dr. Warren Kendall Lewis, right, "the father of modern chemical engineering," was awarded the API's Gold Medal for Distinguished Achievement. He is congratulated by Gen. Ernest O. Thompson of the Texas Railroad Commission, who received the top honor in 1951. Dr. Lewis, professor emeritus at Massachusetts Institute of Technology, was cited for pioneering development of fluidization which revolutionized refinery practices throughout the world.

While the short-range outlook for oil is painful, the medium-range and long-range prospects for energy consumption are so bright that the industry must keep ready to expand still more. Much of this expansion unquestionably will be in foreign countries.

. . . Competition will stay keen in the oil business, during bad times or good.

There will be more competition from other forms of energy, among petroleum-based fuels, between domestic and foreign producers, and within each segment of the industry.

Getting the capital for the inevitable future expansion—to say nothing of staying in business now—is a major problem. Among other reasons, the lack of a sufficient depletion tax allowance is forcing oil producers into liquidation.

Oil to hit back . . . If oil is in for a rough time, oil's critics are in for a rougher one.

If the new API board chairman, Shell Oil's "Max" Burns, can stimulate the industry into adopting half his program, oil will be seen in a new role.

It will be a fighting role, no longer the role of the whipping boy. Burns wants the industry to take the offensive, to hit back at its critics, to beat down bad legislation, to give the public the facts of oil.

And whether by prearrangement or coincidence, Burns' election was followed by a remarkably frank and explicit speech by a scholarly independent producer, Charlton Lyons. He spelled out in detail many of the ideas that seem to be on Burns' mind.

So the general feeling of the oil industry, as reflected at this API meeting, can be summed up:

The situation is bad, but it can be licked.

And the ways to lick it have proved successful in the past: ingenuity, analysis, determination, and a lot of hard work.

WHAT THE PUBLIC THINKS is a concern of these oil executives. H. S. M. Burns, outgoing chairman of API public relations and incoming chairman of the API board, chats with two experienced public relations men on their problems. At left he talks with W. R. Huber of Gulf Oil Corp. and at right with Richard Rollins of Atlantic Refining Co.

New "Public Affairs" Program Mapped

DIRECTORS OF API last week took a hard look at their public-relations and legislative programs and agreed the two should work together.

So the Oil Information Committee and the American Petroleum Industries Committee are going to be merged.

Eventually they will be consolidated into a new "Public Affairs Division" of the API. The process may take some time, but the board ordered it accomplished "at the earliest possible date".

In the meantime neither OIC nor APIC will be shaken up very drastically. Their personnel and programs will continue about as now, but they will be brought into constantly closer coordination.

"They've got to be married, and I'll have to perform the ceremony," was the way H.S.M. Burns, new API board chairman, explained the consolidation problem.

New boss . . . There will be a public-affairs director to supervise activities of the consolidated staff.

But the board seems to be in no hurry to make an appointment.

A public-affairs committee, composed of industry executives, will be set up to report to the board.

"Eventually," said Burns, "I would like to see a new paid vice president of API working exclusively in this field of public affairs. It's that important."

The new program doesn't call for any special curtailment of OIC activities at this time. The budget for next year will be about the same as at present. Decision on a new advertising program in general magazines was postponed until the February meeting of the board.

Division of interests . . . For years before and since OIC was created, APIC devoted its attention to combating unfavorable state and federal legislation, particularly on taxes. Its central staff made economic studies and prepared material for use at legislative hearings. Local industry committees, chiefly lawyers, disseminated this material and often did direct lobbying.

OIC has always stayed strictly away from anything resembling lobbying. It seldom mentioned controversial legislative proposals except in general terms. Its job was to educate the public about the nature of the oil industry and how it operates.

This limitation often made it appear that OIC was asleep when the fire bell rang. It received criticism for not jumping into fights to defend the industry.

Now this is going to be changed. Just how far and how fast the change will proceed remains to be seen.

Chips may fly . . . With Shell Oil's dynamic and plain speaking Max Burns in the driver's seat, results should begin to show up soon.

"We've done a pretty good job over all," he says. "The industry still gets attacked, but more people seem willing to listen to our side of the story, and to believe it. There are fewer snide and vindictive editorials about oil than in the past.

"But we still have to combat a vindictive attitude by some people in Washington."

On this point Burns wants to go ahead with the long-discussed plan to appoint a Washington representative of API. No one has been selected for the post yet.

No sitting on hands . . . A new spirit in oil's public relations may be evident soon if Burns has his way.

"I'm going to see to it that oil-company executives get off their cans and appear in public more," he says.

"They've got to make more speeches and testify in person before congressional committees instead of sending a lawyer. The congressmen will listen to them. In fact, I think they're a bit afraid of oil executives. They've been building us up as big shots so long that they seem to believe it.

"There's an awful feeling of pussy-footing in the oil industry. We're too bloody modest. We've got to get up and tell the folks. Whenever something happens, we've got to pop up and shout 'now hear this.' We've got to come out swinging."

Socony's Albert McIntosh had an optimistic report for API statisticians. He predicts:

DEMAND IN 1958:

U. S. (Domestic)	Up	2.6%
Free World	Up	5.4%

(Thousands of barrels daily)

	1957 estimated	1958 forecast	Change from 1957 Volume	Change from 1957 Per cent
Total demand U. S.	9,476	9,442	— 34	— 0.4
Exports from U. S.	565	299	—266	—47.1
Domestic demand U. S.	**8,911**	**9,143**	**+232**	**+ 2.6**
Gasoline	3,835	3,950	+115	+ 3.0
Middle distillates	2,037	2,085	+ 48	+ 2.4
Residual fuel oil	1,523	1,523	0	0
All other products	1,516	1,585	+ 69	+ 4.6
Free foreign countries	**7,187**	**7,823**	**+636**	**+ 8.8**
Total free world	**16,098**	**16,966**	**+868**	**+ 5.4**

Demand Looks Good

. . . if you look at it in terms of volume of products and not merely as a percentage increase over the last year.

AN OLD HAND at supplying both short-term and long-range guesses at future oil demand, both in this country and in the free world, thinks the oil industry is in pretty good shape.

The coming year won't measure up to the last few in the rate of increase in demand. But, what's [illegible] it?

The oil industry has moved so far and so fast in its recent development, it's spoiled. Now is the time to stop, take a breather, reflect, take stock, mend its fences, and do some of the things it didn't have the time to do in the frantic race to keep up with a mounting demand.

That was the advice handed the session on petroleum statistics at the Chicago meeting of the API last week by Albert J. McIntosh of Socony Mobil Oil Co.

McIntosh is about as qualified as anyone to chide the industry for its fears and call attention to past poor guesses. He can point to several of his own miscalls—and he did. He concedes that 1958 may show up a little on the weak side in demand in the light of the continuing spiral of increased demand in the last few years (see table).

But, McIntosh contends, too many people in the oil industry are conditioned to think of demand in terms of a percentage increase over last year. When the percentage increase doesn't quite come up to par, gloom prevails. He admits that his prediction for only a 3 per cent increase in gasoline demand for next year, compared with an annual average of 6 per cent since World War II, looks pretty modest.

He stresses that percentage increases are getting harder and harder to keep up with. Every percentage point increase today, means a great deal in volume. And, as McIntosh says, the oil industry sells volumes—not percentage points.

With this basic philosophy, McIntosh unveiled his forecasts for 1958. They aren't too encouraging in the light of past years' rates of demand increase. Then he took a longer look and painted a picture of the long-range demand picture that looks better (see charts).

Here's his view of 1958:

. . . A 2.6 per cent increase in domestic demand for all products. McIntosh doesn't think this is too bad, in spite of the fact that it doesn't measure up very well to past years' increases and especially on top of the past year's disappointingly low increase.

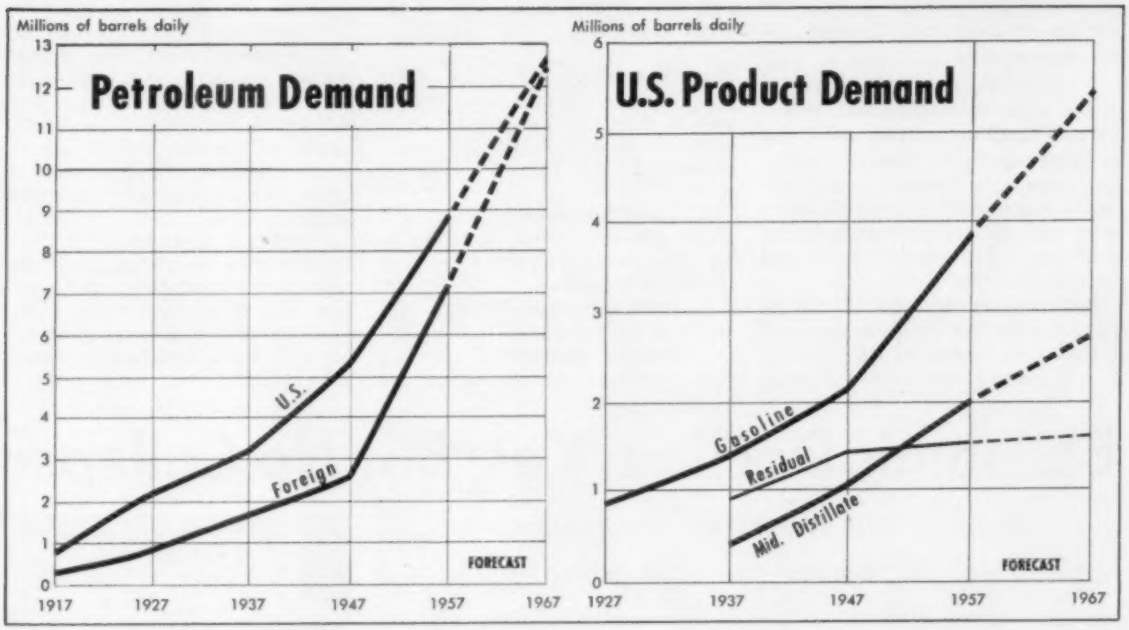
In fact, he says you have to go back to the depression years to find two such poor years in a row.

. . . A 3 per cent increase for all gasolines. This, he says, doesn't appear to be much in the light of the average of a 6 per cent increase per year in the postwar period, but he points out that the increased volume of gasoline sales for 1958 will be greater than the volume increases in 1957, 1956, 1954, and is just about the same as the increase in volumes in 1949.

. . . A 2.4 per cent increase in middle distillates. This admittedly isn't much in terms of percentage points, but it's something else again when expressed as 2,085,000 bbl. daily.

Several things contribute to the slight rise in increased demand for middle distillates. McIntosh mentions the fact that railroads by now are pretty well dieselized; new home building is down from high levels of the past; and, gas and electricity are both making aggressive drives for the home heating markets which once gave this product a healthy future each year.

. . . Residual fuels will move sidewise, neither down nor up. Domestic producers of heavy resids are still keeping output at a minimum. The peaks and valleys of this demand will still be met by imports. Any customer need of resid can easily be met



by more imports or by a change in domestic refiner output.

. . . An 8 per cent increase in jet fuels. This product will keep moving upward with the military taking most of the output. But, McIntosh points out, it won't be long before both domestic and international airlines will be in the market for more and more of the volume.

. . . A 4.1 increase in "all the rest" of the petroleum products. McIntosh includes lubricants, wax, coke, road oil and asphalt, LPG, still gas, and the petroleum products in petrochemicals.

Lubes, wax, and coke, will be pretty stable, he believes, but the rest can be considered as oil's growth products in the future.

. . . Exports are going to drop pretty drastically. But the normal trend for U. S. exports is downward. Too, the Suez crisis and inflated imports during the first half of 1957 gave a false base for comparison. McIntosh sees a 47 per cent decline in exports.

The brighter side . . . The Socony economist sees a brighter side to the picture than the one expressed in these percentage increases.

To prove his point he took a look at the past; then a look at the future.

He recalls that he was a member of a forecast committee in 1944 which predicted a domestic demand for the United States in 1958 of 5,450,000 bbl. daily—not 9,150,000 which he now thinks it will be.

The same committee set 1958 gasoline demand at 2,500,000 bbl. daily—not 3,950,000 bbl. daily which he now foresees.

The coming year is one of "adjustment," McIntosh says.

"Maybe that's a good time to mend our industrial fences and concentrate on some of the things we haven't been able to do so well when most of our attention has had to be given to finding more oil . . ."

The coming year, with fewer demands on time for growth, might be what he calls "an excellent time to concentrate on improved public relations and internal studies of our social performance."

The long look . . . For a man who concedes his past errors in forecasts—and now cites them to prove his point—McIntosh is not one to dodge future predictions. He can take a look at 1967 almost as easily as 1958.

Here are his predictions for 1967, which he credits to Socony's economics department:

. . . Total U. S. demand will reach 12,850,000 bbl. daily. This amounts to an average growth of 337,000 bbl. daily every year between now and then.

. . . A free-world demand of 25,000,000 bbl. daily. About this time foreign consumption should pass the United States for the first time. And the rate of petroleum sales worldwide will top 1957 by 56 per cent. At this point, the potential for further expansion will still be great.

To top it all off, McIntosh says:

"Rather than worry about the small rate of growth envisioned for 1958, we should really be worried as to how we can finance and create the facilities necessary to meet the demands for 1967."

Spending Is Off

. . . for capital goods, and it may not pick up for several months. But other factors are easing the dip.

IT'S BECOMING clearer every week that capital spending by private companies will keep slipping in the months ahead.

But even if it dropped 13 per cent—which it did in 1948-49—it still would be higher than in 1955. And a 13 per cent drop is twice as much as is predicted in most current forecasts.

So, while there is concern over capital spending, any over-all business decline could well be moderate and short-lived.

That's the picture outlined to API registrants by Martin R. Gainsbrugh, chief economist of the National Industrial Conference Board, New York.

On the dark side . . . The main cause

of concern, Gainsbrugh said, is the duration and magnitude of the drop in capital expenditures.

It's something that won't cure itself in just a few months, he said. In the 1948-49 recession, industry saw a year of declining capital spending before an upturn in the first quarter of 1950. In the business dip of 1953-54, there were six quarters of decline before spending picked up in the second quarter of 1955.

"At least in the postwar record, there has been no evidence that once a decline in capital spending sets in, it will last only one or two quarters and then reverse direction," Gainsbrugh declared.

The bright side . . . "Sobering as the prospective decline in capital spending may be, there still remain current elements of strength in the economy," Gainsbrugh said. Here are some of them:

. . . Consumer spending for soft goods and services was still rising in the third quarter, although retail sales dipped in September.

. . . Government spending on a state and local basis continued to rise.

. . . Federal government spending early next year may quit falling and level off. Any further decline in defense spending will be modest.

. . . Construction spending in October rose to the highest level in history—a rate of $48 billion a year. Residential construction was particularly encouraging, chalking up the fourth straight month of increased activity since the decline that started in 1956.

Gainsbrugh said that while backlogs of orders for capital goods have now passed their peak, at midyear they were 60 per cent higher than 2 years ago and at the end of September still were "significantly higher" than in 1955.

Economic Decline, Yes; But No Collapse

Dr. Nadler of NYU says there's nothing surprising in the bleak outlook. Business has been getting too fat and must go on a diet. It'll wind up healthier than before.

A DEPRESSION of major proportions absolutely cannot occur within the next few years.

Business activity will decline in 1958, and the recovery will go through a readjustment. But there is no basis for some of the extremes of pessimism now running through business circles.

After certain maladjustments have been corrected, our dynamic economy will go ahead to higher and more profitable levels.

Such was the frank diagnosis of Dr. Marcus Nadler of the Graduate School of Business Administration, New York University, as given to the API division of Finance and Accounting.

The readjustment next year will be painful but necessary, Nadler warned. When a child overeats he isn't desperately ill but needs a dose of castor oil. American business has been overindulging and now is going on a diet. This is unpleasant, but the patient will survive and be better off for it.

This readjustment will separate the men from the boys, the noted professor said. He explained that when a man comes to a mud puddle he gingerly walks around it, but a boy splashes through the middle. Then he asked, "Is there mud on your shoes?"

The signs were there . . . There is nothing strange about how we got into our present predicament, Nadler insisted. All of it could have been foreseen.

In the summer of 1953 business activity began to turn down. So the Federal Reserve began open-market operations and created credit. At the same time an extremely liberal veterans' housing program was started. People could buy houses, cars, and other things with little down and many months to pay. Sales boomed.

Suddenly shortages of steel, aluminum, and other things began to appear. This caused an investment boom, with widespread construction of new plants, equipment, and office buildings.

Now the productive capacity of the country has been expanded beyond its effective demand. Most industries are operating below their capacity. Competition is severe. Profits are squeezed. Now money has tightened up again.

Today's picture . . . Here's the situation now, as Nadler analyzed it:

The investment boom is over—temporarily. (And don't ask an economist how long "temporarily" is.)

Capital spending for expansion is decreasing. Some estimates are that it will be 7 per cent below 1957, but it is likely to drop considerably lower than that.

The office-building boom is over.

Exports have hit or passed their peak, due to dollar shortages and restrictions in some foreign countries.

The boom in Europe appears to be tapering off.

Money and credit are tight.

The economic sentiment has changed. And the psychological attitude of both individuals and company executives toward the future is a very important factor in business activity.

DR. MARCUS NADLER
. . . there's a bright side, too.

Inventories are beginning to decline, after an increase that piled up when consumers began to reduce their buying.

The bull market in equities is ended. This makes individual stockholders feel less rich and deters company treasurers from floating more securities.

Company executives are beginning to sharpen their pencils, pinch pennies, and cut expenses. "A pair of tickets to 'My Fair Lady' for a client at $25 suddenly becomes a major issue."

What next? . . . So where do we go from here? Nadler asked. "Nobody

knows—and it's probably just as well that we don't know."

But he predicted: Corporate investments will decrease. There is no new source in sight to change this trend.

Government expenditures will not increase unless Congress should raise the debt limit next year. If the country is sufficiently scared and had its pride hurt by the Russian Sputnik, the lid might be taken off the public debt, and this would start an armaments boom leading to a dangerous inflationary cycle. But if the debt limit is raised by only 2 or 3 billion dollars it will not have a major effect on the economy.

Consumption expenditures for nondurables and services will increase. Expenditures for consumer durable goods in 1958 probably will be lower than in 1957 because installment buying will not be liberalized and many people will try to get out of debt.

Employment opportunities will be fewer, and there will be less overtime.

Outside of the Government there are no major forces that could push the economy up. There are several that could push it down.

The Government will bring money rates down. But there will be a time lag before the effects of this are felt.

There is a slight possibility of a reduction in individual income-tax rates. But this will be for political rather than economic purposes and will have no big effect on the economy.

Public works will be stimulated.

The future . . . Down the road, nobody knows whether the readjustment will be as mild as in 1952-54, as pronounced as in 1948-49, or of more serious proportions. But Nadler was positive it will not lead to another major depression.

Some strong upward forces will become effective within a "relatively" short time. Nadler wouldn't say when, but listed these forces:

Disposal income in the hands of the people is high, and their economic security is great.

There will be higher local expenditures to take care of our growing population — roads, schools, playgrounds, hospitals.

Our economy is dynamic because, readjustment or not, the birthrate will stay up. And every new baby immediately becomes a consumer—of textiles first and other things rapidly.

Research continues, creating new things.

What's needed . . . But certain conditions, Nadler said, must be corrected before the economy becomes really strong again.

Discrepancies in wages must be corrected. In some industries, notably home building, wages have got so high that people can't buy the products.

Productive capacity is too great for the "immediate" future, and the market will have to be expanded up to it.

Private indebtedness is very large. The boom was based on borrowed money, and some debts will have to be retired before a new boom can start.

Psychological factors must be more favorable to spending. Nearly 50 per cent of consumer expenditures are optional.

The international political situation must become more certain before there can be confidence to spend and invest.

If all these adverse conditions show their effects at the same time, the business decline will be deeper and last longer than is now expected. If several of them are corrected rapidly, the recession will be mild.

TWO NEW OFFICERS flank an old one. Left to right are Williard M. Wilson, who succeeded Lacey Walker; Frank Porter, who continues as president; and H. S. M. Burns, new chairman of the board.

API Elects New Officers

A COLORFUL SCRAPPER for oil-industry rights, impatient with the timidity of his colleagues and ready to spur them to more effective action, was elected chairman of the American Petroleum Institute last week.

The new chairman is H. S. M. Burns, president of Shell Oil Co., New York, who is already widely known as an oil spokesman (p. 136). He succeeds Jake L. Hamon, Dallas independent producer.

C. E. SPAHR

Frank M. Porter, president of Fain-Porter Drilling Co., Oklahoma City, was reelected president of API.

C. E. Spahr, vice president of Standard Oil Co. (Ohio), Cleveland, was elected vice president for transportation. He takes over from Frank O. Prior, president of Standard Oil Co. (Ind.), Chicago.

The API reelected the following vice presidents: H. W. Ferguson, Humble Oil & Refining Co., Houston, vice president for refining; Dwight T. Colley, Atlantic Refining Co., Philadelphia, vice president for marketing; and D. L. Connelly, Warren Petroleum Corp., Houston, vice president for production.

B. Brewster Jennings, chairman of Socony Mobil Oil Co., Inc., New York, was reelected treasurer. Williard M. Wilson, assistant director of the American Petroleum Industries Committee, New York, was elected secretary, succeeding Lacey Walker, who retired earlier this year.

The new president of API's Twenty-Five Year Club is John R. Suman, consultant of Houston.

MAX BURNS new API chairman, has fighting program for 1958 based upon:

1. TOP WORKERS: "We need to get some people off their cans and performing for the oil industry."

2. CONFIDENCE: "Too many oil men say things are going to hell . . . Americans need a pep talk."

3. A PLAN: "We've got to get out and tell the folks . . . in Washington a fighting program."

THAT'S THE WAY a ruddy-faced, hefty Scot sees his job as chairman of the American Petroleum Institute, one of the toughest honorary jobs in the industry.

Until last week H. S. M. Burns had a pretty good-sized job as president of Shell Oil Co. Now he's strapping on his fighting togs to inject more vigor into the oil industry's affairs.

The bounce of his own conversation is an indication of his approach to this new job. He sums up oil men like this: "We're inclined to be too bloody modest in the oil business."

And his first step: "I'm going to dedicate myself to getting some people off their cans and performing for the industry."

Burns in these words spoken in an interview was talking about the top executives in the industry. They're the people he thinks should be talking up and telling oil's story.

Other voices, too . . . The top executives aren't necessarily the only ones Burns would like to shake up a bit.

"There are too many who give only lip service to the API. They drop in for a free lunch, and that's it.

"It's time for those people to get interested in all the problems of the industry.

The new API chairman also has some positive thoughts ready on a lot of subjects, including:

. . . Oil's No. 1 problem — supply and demand.

"There's nothing wrong with the oil industry that one good cold weekend won't cure.

"We're in another warm heating-oil season. We more or less expect gasoline to be soft at this season, but not heating oils. Buyers aren't stocking up. A lot of oil men are helping this soft market along with their pessimism. The buyers are waiting for the first one to break the price.

. . . Pessimism.

"Too many oil men are going around saying things are going to hell. If we keep saying they are going that way, they will."

. . . Sputnik and our economy.

"Sputnik is immaterial. The American people need a pep talk. The sputniks don't prove we're behind in scientific progress. We're just behind in our coordination of science on this thing.

"Sputnik is an interesting experiment in rockets. We should have done something like that on the Fourth of July. That's the time for rockets. This doesn't mean the Russians can fire an intercontinental missile.

"When you talk of missiles, you have to be able to say the things will land at Main and Second in Moscow on a certain day or they don't mean a thing.

. . . Public relations.

"We plan to make the program more effective. What we are thinking is an interweaving of long-range and short-range efforts—to work more together.

"We're going to have a marriage of our fire prevention unit (the OIC) and the fire-fighting unit (APIC). It looks like I'm going to be the preacher."

. . . Washington and the industry.

"The API is going to take a part in Washington. We plan to have an active fighting program. We hope to establish a Washington representative. We haven't picked one yet.

"We have to have the Rathbones, the Jennings, the Pews, the Millikans, and men like them speaking up for industry. There's nobody more effective at a hearing than a man who knows and can lay it on the line.

. . . Shrinking violets.

"There's an awful feeling of pussyfooting in the oil business. We've got to get out and tell the folks.

"Whenever something happens we've got to pop up and shout, 'Now Hear This.' We've got to come out swinging."

About the man . . . Burns was born in Aberdeen, Scotland, in 1900.

As a teen-ager during World War I he served with the Royal Artillery. He left the service to study geology and chemistry at the University of Aberdeen, later received his master's degree in mathematics and physics at Cambridge.

Burns went to work for Shell on the U. S. West Coast and was put through various training jobs. By 1929 he had risen to assistant general sales manager. Later he became division manager and then general sales manager.

After tours of duty for Shell in London, Venezuela, and Colombia, Burns returned to the United States in 1946 as senior vice president. In 1947 he was elected president.

Imports Administrator Carson spells out program's progress to date.

Three Importers Rapped

. . . for exceeding allotments. Carson lauds voluntary plan and warns against "chain reaction" of government control.

ONLY THREE IMPORTERS—"a small, lonely minority"—are not cooperating with the voluntary program for limiting oil imports, Capt. M. V. Carson, Jr., imports administrator, reported to the API.

He named these as Eastern States Petroleum Co., Inc., Sun Oil Co., and Tidewater Oil Co. He explained that Standard Oil Co. (Ohio), at one time considered to be a holdout, has assured him of its cooperation for the entire period ending June 30, 1958.

Even with these three firms not fully complying with their assigned allotments, Carson said, total crude imports east of the Rockies were only 16,000 bbl. per day above the recommendation. If the three adhere to their presently announced plans they will exceed their allotments by 46,000 bbl. per day in December and by 38,000 bbl. per day during January and February.

Carson called the over-all program "especially encouraging" and close to success, but he added, "I sincerely hope that the companies I have mentioned will take a longer look into the future and judge their actions accordingly."

Public opinion and private pressure are being relied on to make the voluntary program work, Carson indicated, and he made it plain that the alternative is mandatory federal enforcement of a similar quota system rather than any different approach to the imports problem.

Dangerous alternative . . . "The federal Government would like to depend upon the industry to regulate its volume of imports on a voluntary basis," he said. "But only so long as the voluntary method is successful does the petroleum industry have any strong measure of insurance against governmental controls—either by administrative action under the Trade Agreements Act or by future legislative decree.

"Speaking historically, once controls on one segment of an industry have been established, a chain reaction is set up which almost invariably leads to increased governmental control over all phases of activity.

"If supplies are restricted, a clamor for price control arises from consumers when costs go up. Price controls, in turn, lead to rationing to insure equitable distribution of supplies. Then, some people turn to black or gray market activities to evade the effect of rationing, leading finally to law enforcement proceedings against those who sell or purchase illegally.

"This dire picture is not an idle dream, a flight of fancy. Rather, it has been the ultimate experience of almost every commodity put under government control in almost every nation of the world. These things have been the end results—the inexorable logical extensions—of mandatory controls," he said.

"I wonder who among you—regardless of your position in this matter—would wish this fate upon your magnificent industry."

Working policy . . . Carson stressed that the imports program "is a basic statement of administration policy . . . a working policy document of the United States Government. It is our firm intention that this policy will be carried out."

He told the API delegates the success of the program is within the grasp of their industry, "but failure also is within your hands."

"There is no easy way. The industry cannot afford to adopt a course of expediency, or the course which promises the least discomfort. You cannot be the victims of wishful thinking that everything will work out without personal effort."

Lyons Scolds Oil Men, Offers Program

Shreveport independent offers these solutions to oil's shortcomings: Industry solidarity, new public-relations program, Washington office headed by experienced man.

THE OIL INDUSTRY is already half convicted and a guilty verdict is going to be returned by the American public unless oil men quit scrapping among themselves.

That was the blunt prediction made to the API by Charlton H. Lyons, Shreveport producer and president of Mid-Continent Oil and Gas Association. Next to what he calls socialism in Government, he thinks squabbles within the industry and the failure of oil to speak up and defend itself are its worst problems.

"Today, oil men are their own worst enemies," Lyons says.

Lyons not only took his listeners to task for their shortcomings, he also told them specifically what he thinks the industry has to do to solve its problem both with the public and in Washington.

"I submit that all thoughtful oil men must now conclude they, themselves, are undermining the confidence of the American public in the industry."

Lyons says its no wonder to him that the public is suspicious of everything connected with oil. That's bound to happen when one segment of the business calls another "monopolistic," "rapacious," and "unscrupulous," and, the other segment answers in the same kind of language, or worse.

As examples of what he means, Lyons cited the bitter California battle over conservation-unitization legislation, the scrap over the Harris bill last year, and the current controversy over imports.

No one really won any of these battles. The entire industry suffered in the eyes of the American public. And, the industry's "enemies" in Washington were handed ammunition in wholesale lots.

Lyons' solution . . . The Shreveport producer, who has also headed the IPAA as president, proposed a four-point program which he urged his listeners to adopt. Basically it would include the following:

. . . Industry solidarity, which he doesn't propose as conformity or unanimity, but broad unit of purpose.

. . . A changed public-relations emphasis. Lyons says the industry's public-relations program should give the American people simple, forthright answers to the questions it wants answered.

. . . An oil and gas economics institute to be located in Washington to represent the industry.

. . . A Washington office of the API with a competent director to present the industry's views to Congress and the Government.

Solidarity . . . Lyons believes strongly that the different segments of the industry have to present a solid front. He hastens to add that he doesn't mean conformity.

"In an industry as dynamic as the petroleum industry, controversy is inevitable. . . . Controversy acts to check and balance divergent views resulting in benefit for all. It shows the industry is competitive."

His objection to the present and past controversies of the industry is that they have not been constructive.

"Controversy should be objective and constructive. It should be calculated to bring about public understanding and approval, both of oil men themselves and the industry."

In the past, he says, "too often opposition has been by canard and ephithet." He cites the battles between the importers and independents before congressional committees during the oil lift to Europe.

An independent himself, Lyons told the API that the charges made by independent producers were not "germane to the question of imports" and they were not substantiated by facts.

He said flatly that many independent producers think imports are the sole cause of their troubles and they are mistaken. He charged both importers and independents with being wrong in charging each other with failure to meet Europe's oil needs. All the time, he added, Europe's needs were being met, but no one told the story until too late because everyone was busy accusing someone else of falling down on the job.

Public relations . . . Lyons says there is no longer any need for the industry to stress its importance, efficiency, its achievements, and its problems.

The American people want to know the answers to five basic questions and they deserve simple forthright answers to each. He listed them as:

. . . Is enough oil going to be available in the future?

. . . Is the industry truly competitive?

. . . Are petroleum prices reasonable?

Fundamental research is the job tackled by this hard-working API committee. API research has opened the way for new petroleum processing methods, produced data for hundreds of technical publications, provided a training ground for scientists, and stimulated academic research in petroleum.

Lacey Walker's retirement as secretary of API last March didn't keep him from serving as major domo at the thirty-seventh annual convention last week. The API was just 21 months old when he joined it in 1921. Walker's tenure with the Institute has seen a lot of changes. The first annual meeting in 1920 attracted only 420. The next year Walker's first meeting drew 537. Registration this year hit 6,455. Walker has served as API secretary for over 30 years and until 3 years ago was also assistant treasurer in charge of raising the Institute's budget.

... **Are oil's profits** in line with those of other businesses?

... **Does the industry pay** its fair share of taxes?

The economics institute . . . Lyons believes the oil and gas economics institute should be located in Washington and that it should function under API. If not under API, it should work under a group of trade associations.

He listed the following functions for such a unit:

... **Develop and keep current** basic economic data affecting oil and gas.

... **Analyze proposed legislation,** judicial, and administrative actions to determine their effect on the industry.

... **Make studies of the industry's** tax structure.

... **Make studies of oil's position** in the energy requirements of the nation.

... **Make all studies available** to Congress and federal and state agencies and officials.

... **Maintain a reference** research library on economic matters affecting the industry.

API in Washington . . . Lyons says the need to establish a Washington office of the API adequately staffed and operating under a competent director is "immediate and urgent."

He points out that the industry has no organized way to present its views to Congress and the Government.

Now, he says, the only time oil shows up in Washington is when it is in trouble, then, this "firefighting" department is made up of volunteer amateurs.

"They are capable men in their particular fields, but they are usually novices when it comes to handling the affairs of the industry in Washington," Lyons said.

Here are his proposed functions for the Washington director:

... **Establish general industry** understanding. He would not be a spokesman for the industry, but "an ambassador within and for the industry."

... **Keep congressmen** and the Government informed on essential oil matters, particularly pending legislation.

... **Anticipate trouble** and prevent it.

... **Speak up objectively** and in time. Lyons said oil's silence or delay in talking out has been construed in the past as a confession of guilt.

... **Call on industry** leaders to speak out when the industry is attacked.

Jersey Holds Birthday Party

STANDARD OIL CO. (N. J.) celebrated its seventy-fifth anniversary last week at the API with a party befitting the world's largest oil company.

Hundreds of oil men remained in Chicago through Wednesday evening to attend the reception in the Grand Ballroom of the Conrad Hilton Hotel. The formal convention program ended earlier in the day.

Eugene Holman, chairman of the board, and M. J. Rathbone, president of Jersey Standard, greeted each guest. The menu of exotic hors d'oeuvres was headed appropriately by oysters Rockefeller.

Big Steel Inventory

should be shared by major oil firms, steel official says

THE GROWING BURDEN of oil-country steel inventories must be shared by major oil companies and distributors as well as manufacturers of steel.

That's the thinking of Henry J. Wallace, vice president of sales for National Tube Division of U. S. Steel Corp.

Wallace told members of the API that he knows of no other steel-mill product where the manufacturer carries inventories of the volume required by the drilling industry.

He said that in some quarters "there continues to be a feeling that the manufacturers should and will assume the entire inventory burden . . . But the magnitude of the problem is such that the burden must be shared, at least by major oil companies for their own use and by distributors for servicing the independent producers."

The hot issue of inventories came to a head by a shift from a sellers' market to a buyers' market. This is the result of two big factors: Drilling is down and tubular-goods production is up.

The first big postwar drilling slump happened to coincide with the biggest increase in oil-country steel production since World War II. Production is up 400,000 tons this year.

Wallace said that production and consumption were in balance last year only because of the 6-week steel strike.

He pointed out that major companies, distributors, and independent producers for years have bought stocks to guard against shortages. Now that tubular goods are readily available, buying habits have shifted sharply.

Foreign Oil Is No Cinch

. . . says Socony president. Overseas exploration plagued by unstable governments, lack of markets, and costly outlays.

THE SEARCH for oil abroad is a far cry from "putting nickels in a slot machine rigged to pay off." It's fraught with trials and tribulations never dreamed of by many U. S. oil men.

The experience of Socony Mobil Oil Co., Inc., was recounted by Albert L. Nickerson, the company's president, to point up the realities of oil finding outside the United States.

Nickerson, speaking before the API Division of Production session, cited these overseas problems:

. . . **Investments may prove unsafe** because of action by governments to change operating rules.

. . . **Government red tape** may prevent a company from getting full value for its exploration dollar.

. . . **Dealing with governments,** rather than individuals as in the U. S., places companies at a disadvantage.

. . . **There may be no nearby market** even if the explorer finds oil. This is unlike the U. S. where markets are generally ready and waiting in normal times.

. . . **Size of the outlay** may be prohibitive because well costs are only part of the bill. Often roads, pipelines, terminals, harbor facilities, and even towns must be built.

Socony's experience . . . To prove that the international oil business is no cinch, Nickerson cites his company's experience over the world:

. . . **In Europe,** 40 years of searching has failed to find enough oil to supply the company's local marketing needs. Some properties were destroyed by war or confiscated by expropriation in the case of eastern Europe.

. . . **In Iraq,** the payout, ignoring interest on capital invested, was 25 years in coming.

. . . **In the Far East,** operations of the affiliated Standard Vacuum Oil Co. (Socony and Jersey Standard) have been interrupted by World War II; China assets were confiscated; and Sumatran fields required years to return to prewar production levels.

. . . **In Colombia,** "we have found so little oil that we have yet to recover the substantial sums we have invested over the past 21 years."

Experience in Saudi Arabia and Venezuela has been profitable. "Venezuela is finally on a paying basis."

"Taken as a whole," Nickerson said, "our foreign investments have been profitable, some of them very satisfactorily so. But there have been many disappointments. Of these, some have involved losses of a substantial character. No one should venture abroad who is not prepared to face losses."

He cautioned "amateur" foreign operators not to forget the problem of marketing when they start exploring.

Imports . . . Noting that Socony, a substantial importer, has agreed to cooperate with the voluntary control program, Nickerson said imports is but one of many factors responsible for proration.

He listed the growth of natural gas, which is being consumed at the energy equivalent to 3,000,000 bbl. daily of crude above 1947; revival of the coal industry; and the warming trend in weather. Observing that the U. S. may need 40 per cent more oil 10 years from now, he questioned the ability of domestic producers to supply this market.

He said a strict limitation on imports may well sound like a solution to the present soft crude market but warned that restrictions could tend to price oil out of some markets.

He added that "fair play" with overseas oil is a must if it is to be available when it's needed:

"One thing that could lead to public-utility status for our industry quicker than anything else would be our inability to meet demand in this country."

Offsetting these factors, however, is the main reason for the increasing search for oil abroad: "There are more unexplored and untested areas which look geologically attractive outside the United States than inside it." Another reason is the increasing costs of finding oil in the U. S.

Drilling practices are studied by steering committee headed by Jack H. Abernathy (left at head table), Big Chief Drilling Co., Oklahoma City. Abernathy and Roy F. Carlson (at right), assistant director, Division of Production, API, listen to a suggestion from the floor.

IDEAS FOR CUTTING COSTS of petroleum buyers and sellers are offered by F. M. Mayer, Continental-Emsco Co. Other speakers at session (left to right) are Reese H. Taylor, Union Oil Co. of California; Henry J. Wallace, National Tube Division, U. S. Steel Corp.; and Thomas W. Phelps, Socony Mobil Oil Co., Inc.

Price of Foreign Oil Key to Drilling

. . . in future domestic fields. Optimistic forecasts have overlooked this, Continental-Emsco president says.

THE PRICE OF FOREIGN oil has become, and will continue to be, a significant factor in future drilling activity in the U. S. That's the prediction of F. M. Mayer, president of Continental-Emsco Co.

Mayer told members of the API that optimistic drilling forecasts for the U. S. are discounting the very important element of the price of foreign oil.

"It is fundamental," he said, "that if costs of drilling and producing oil in the U. S. continue to mount as rapidly as they have in the last few years, any such optimistic forecasts are at best wishful thinking."

He said most forecasts are based on projected consumption and on the assumption that the domestic industry will drill enough wells to maintain the present ratio of reserves to production.

He also noted that foreign manufacturers are now turning out most of the drilling, producing, and refining equipment formerly made almost exclusively in the U. S.

Cutting costs . . . Mayer offered suggestions for cooperation between suppliers and oil companies in cutting costs for both:

. . . Eliminate duplicate facilities for ordering and delivering supplies in the field.

. . . A prompt release of inquiries and requests for quotations to suppliers to permit better merchandising and to reduce rush orders.

. . . Fewer quotations from suppliers to cut expenses of a large number of companies preparing bids when most have no chance for any of the business.

. . . Regular, frequent forecasts of requirements.

. . . Further standardization of equipment to reduce engineering expenses and production costs.

. . . Increased use of knowledge and technical skill which suppliers build up in their staffs.

Pipe Liners Club banquet head table shows J. H. Woods, Jr., Atlantic Pipe Line Co., Dallas; J. Marston Linehan, Mid-Continent Pipe Line Co., Tulsa, L. H. True, Magnolia Pipe Line Co., Dallas; R. H. Lynch, Atlantic Pipe Line Co., Philadelphia; Harry Moreland, Great Lakes Pipe Line Co., Kansas City, Mo.; and Loren F. Kahle, Standard Oil Co. (N.J.), New York.

NUCLEAR-TANKER OUTLOOK was examined by Harry B. Benford, left, associate professor of naval architecture and marine engineering, University of Michigan. With Benford are Frank O. Prior, center, president of Standard Oil Co. (Ind.) and vice president of transportation for API, and H. N. Emerson, Atlantic Refining Co., who spoke on oil transportation preferences and their bases.

Costs Hamper Nuclear Tankers

. . . even though technical feasibility has already been proven by the atomic submarine "Nautilus."

THE SUBMARINE NAUTILUS has proved two things: Nuclear-powered ships are technically possible. But commercially they're still several years away.

A nuclear-powered tanker which is competitive with conventional ships is considered at least 10 years away. It will appear then only if costs can be cut more sharply than most experts now believe possible.

These are the conclusions made in a study by Harry B. Benford of the Department of Naval Architecture and Marine Engineering, University of Michigan. Speaking before the API Division of Transportation, Benford declared:

. . . **Speeds of nuclear ships** won't be much greater than comparable conventional vessels unless some unforeseen technological development brings cheaper nuclear machinery. Other scientists have predicted that nuclear ships could move at double present speeds.

. . . **Cutting power-plant costs** will be more important than increases in thermal efficiency because nuclear fuel will tend to become cheaper.

. . . **Cost cutting** is even more important than reducing weight of nuclear machinery.

. . . **Building and operating** nuclear ships abroad, like conventional ones, will be much cheaper.

Benford cautioned against deceiving investment costs per ton.

He advocated a return to the more basic method of comparing rates of return on investment. This continues to favor the conventional tanker. Although comparisons matching annual fuel savings against first cost of both types of tankers show nuclear ships in a favorable light, this method is deceptive. The reason is that nuclear power also affects most other facets of operating expense.

The competitive situation could be changed sharply, however, by an altered attitude toward investment return.

"If a greatly reduced—but still reasonable—return on investment is acceptable, a nuclear tanker built under present technology could probably pay its own way," he said.

Benford believes that tankers are the type of vessel which could use nuclear power to best advantage. They are expected to lead the way in atomic development. Ore carriers, mobile-cargo ships, and passenger ships also are expected to be considered for nuclear propulsion.

Benford said that "commercial feasibility" of nuclear ships is very controversial. His definition is that "a nuclear ship, to be commercially feasible, must prove as good an investment as a conventional ship and not merely carry cargo as cheaply." Hence his emphasis on return on investment rather than cost studies based on cost per ton of cargo and studies matching fuel savings against first cost.

Benford's study, rather than drawing definite conclusions as to specific costs, sets up a good pattern to follow for a company desiring to investigate the feasibility of a particular application of nuclear propulsion.

New Control Bills

pose big threat to industry in next session, Rubel says

TROUBLE ON THE POTOMAC, more of it than usual, is in store for the industry.

A. C. Rubel, president of Union Oil Co. of California, took a look at the hurdles ahead. The picture he sketched for the API is pretty gloomy.

His address was delivered by Reese H. Taylor, Union Oil's chairman.

He said the Washington trend toward more government control of oil has to be stopped, and soon. Unless it is, oil faces complete socialization "in a very short time."

Here are some of the Washington hurdles Rubel listed:

. . . **Depletion attack on three fronts.** He cited three bills pending which would reduce the 27½ per cent depletion allowance, two of them to 15 per cent and a third to only 5 per cent. A fourth bill would restrict depletion to wells in the United States.

. . . **Threats to the sales structure** of the oil industry in the form of a whole group of bills to "equalize opportunity." Typical are the bills proposed by Sen. Estes Kefauver of Tennessee. They would require proof that a price cut doesn't harm competition and that it had to be granted to meet an equally low price.

. . . **Small-business bills** that would put oil companies in a strait jacket in their business dealings with retail outlets.

. . . **Industry control bills** setting up a national oil commission to regulate all phases of the industry "for national security and economy."

. . . **Public domain bills** to prevent development of public lands by private enterprise.

. . . **Import restrictions** by legislation instead on a voluntary basis.

Refinery equipment committee wrestles with standards problems. At head table are Porter G. Stevens, Standard Oil Co. (Ind.); J. D. Manney, API, committee secretary; and J. C. Ducommun, Standard Oil Co. (Ind.), committee chairman. Standing at left, addressing the committee, is L. G. Molique, Phillips Petroleum Co.

Research Paying Off

. . . in large, regular installments. Findings coming from the lab are more than repaying efforts of API.

ON THIS MUCH oil men agree: Fundamental research is a gamble. Sometimes it pays off. Sometimes it doesn't.

But the oil industry's ante of millions of dollars over the past 30 years is now beginning to pay regular dividends. Some practical benefits, in fact, are beginning to look like jackpots.

Consider a few:

Some sleepers are showing up in high-viscosity lube studies. Compounds with excellent viscosity indices have been found where no one was looking for them.

New slants on combining high-octane streams to get a blending bonus are appearing.

Recent results on heavy sulfur compounds are showing the way to better removal from petroleum.

Even the very basic compilation of hydrocarbon properties is seeing everyday use in developing and designing equipment for new processes.

The result of all this is a growing interest in the basic research conducted under API sponsorship. This interest is well justified.

Future promising . . . This job of opening up the research information box was undertaken last week by H. W. Field and C. E. Headington of Atlantic Refining Co.

They recounted the return on research for the API Advisory Committee is one particular division: Composition and properties of petroleum.

What they had to say was exciting and rewarding. And the promise they held for the future looks even more rewarding.

Against a background of hard, academic investigation of what makes up petroleum, they showed some practical results that mean dollars to refiners. The very methods evolved in making, separating, and evaluating these hydrocarbon pieces have moved technology far down the road. A whole new approach to the analytical chemistry of petroleum has come out of this project.

This, in turn, has enabled chemists to tell refiners what they are working with and what they should be shooting at. Without them refiners could not have developed or even recognized the need for polymerization, alkylation, cat cracking, cat reforming, or isomerization.

Take the amassing of data on thermodynamic and other characteristics of petroleum hydrocarbons. Does anyone ever use such data? Emphatically yes, says Field and Headington. Laboratories report that no process research is ever undertaken until all thermodynamic studies have been made using API data.

Another aspect of the purest sort of research: Spectral data are sparking new ideas in looking far down the road to practical, applied research for new products and better ones.

Bits and pieces of information on the antiknock properties of individual hydrocarbons also are now beginning to shape up a picture of what future motor fuel may look like. This is one area where a payoff may appear.

Other savings . . . Some misconceptions have fallen before the onslaught of pure research.

Refiners always have aimed at putting the long, straightchain "spaghetti" compounds in their lube oils. These invariably are the best for viscosity index, everyone agreed. But research showed otherwise. One pea in the spaghetti, a compact molecule called perhydrofluoranthene, was synthesized and tested to show a viscosity index of 137.

Removing sulfur from petroleum is essentially a hit-or-miss proposition when the refiner doesn't know what kind of sulfur he's dealing with. Some recent findings along this line should shed some significant light on better methods for attacking this problem of identifying sulfur compounds in heavy fractions. These higher-boiling forms have now been revealed as mostly in the form of thiophenes and cyclic sulfides.

Another startling find: Some heavy crude fractions now appear to be composed principally of sulfur compounds contaminated with a few hydrocarbons.

One dividend of this API research effort is only now coming into full recognition in this Sputnik age. Some 30 years of sponsoring projects in universities throughout the country have contributed tellingly to developing disciplined scientists familiar with petroleum and its components. This advantage could not be bought today.

Blending Pattern Evolves

. . . from 19 years of API research. Commercial labs are turning to new data to blend high antiknock components.

A MORE PRECISE pattern for hydrocarbon blending may develop from further research into data compiled during a 19-year-old API research undertaking.

This coupled with a broader knowledge of precombustion studies by others should lead in time to a better understanding of combustion itself.

These conclusions were drawn last week by L. C. Beard, Jr., of Socony Mobil Oil Co. in reporting on API's Fundamental Research Project 45.

Beard declared that learning how to get bonus octanes out of blending materials already at hand may represent the big payoff for the project. The wealth of data compiled by researchers is gaining more and more attention as commercial laboratories seek guidance on blending the high antiknock components of today's and tomorrow's process units.

Times change . . . When the API set up the fundamental research project 19 years ago, octane numbers of 100 and above were of academic interest.

They represent today millions of dollars in invested capital. Any information leading to better use of these costly octanes is money in the bank.

The project since then has established these facts:

. . . Chemical structure greatly affects antiknock ratings.

. . . Branched-chain paraffins show much higher performance ratings than straight-chain paraffins. So do straight-chain olefins.

. . . Aromatics vastly outperform naphthenes with the same number of carbon atoms.

But the project went further. In revealing how these various hydrocarbon types perform when they are blended, it has produced something of new and timely interest.

Blending values . . . For a particular hydrocarbon, its blending value depends on what it is being blended with.

Moreover, the relationship of these octane mixes is not generally linear. A 50-50 blend of 50 R.O.N. and 100 R.O.N. components does not always rate 75 R.O.N.

Project 45 first revealed that when rated by the research method most blends are synergistic. They result in octane ratings which are higher than the weighted average octane of their respective components. Motor-method ratings on the other hand proved generally to be antagonistic. Blend octanes turned out to be lower than one would compute arithmetically.

These findings looked intriguing from a practical standpoint. They also left something to be desired from a technical point of view. So an informal industry group met with Project 45's advisory committee in May 1954, to decide what course the work should follow from that point on.

Out of this came two new concepts.

One was the idea of chemical interaction. It accounts for the variations from straight linear octane ratings in blends of various hydrocarbon types.

The other was the concept of matched blends. It has permitted knock ratings to be made with greater uniformity of engine conditions. This has been the major basis of Project 45's work during the past 2 years.

Matched blends provide a sort of middle ground in engine compression ratio, permitting a better measurement of chemical interaction.

Beard cited an example: The study of an olefin, 2-heptene, in a paraffin blend. Instead of mixing low octane 2-heptene with a single, high-octane paraffin line isooctane, the olefin is blended in varying amounts with a mixture of isooctane and normal heptane. This mixture was adjusted to match the octane rating of 2-heptene itself. This allows the antiknock ratings of the various concentrations to be carried out at a compression ratio or engine severity suitable for testing both blend components.

Progress . . . On this concept of matched blends, the project team went to work evaluating thousands of blends. What they have found could well form the groundwork for "making" millions of dollars worth of extra octanes by proper proportioning of paraffins, olefins, and aromatics.

The work is progressing on the rating of these binary mixtures. In general it has been found that matched blends of the same type of hydrocarbons (paraffins with paraffins, olefins with olefins) give knock ratings that are approximately linear with composition. But blends of different types usually show synergism, or higher than linear ratings, which are accentuated by TEL. Refiners should be warned that some combinations downgrade net octanes.

Curves of many matched blends are now available. Further expansion of these data and better understanding of how to use them hold bright promise for maximum use of octanes in the future.

A bargain in brains is how M. E. Spaght, executive vice president, Shell Oil Co., describes API research. Listening are L. C. Beard, Jr., Socony Mobil Oil Co., Inc.; H. W. Field, Atlantic Refining Co.; and W. E. Kuhn, The Texas Co.

Static Electricity Probed

. . . in new research effort by industry. Use of additives, radioactive isotopes, other measures hold big promise.

OIL MEN have been struggling with static electricity for many years. But now they're doing something about it.

The industry is learning more about the mechanism of this extremely complex phenomenon and will be better able to adjust operations to avoid the growing record of fires in refineries, tankers, and barges, and on tank farms.

A major research effort on several fronts is beginning to show good results. This was brought to light in four important papers presented at the API meeting. (Full text of three of the papers appear in this issue beginning on p. 116.)

While no final solution has been reached, the use of additives, radioactive isotopes, and other measures are whittling at the problem.

Old-line refiners long ago learned to cool kerosine before pumping it to rundown tanks. The old batch agitators, too, were such prolific generators of static electricity that many were designed with explosion relief valves in the roofs.

While refiners didn't know exactly why, they know that certain things spelled trouble: High pumping rates, splash filling of tanks, and unblanketed vapor spaces above certain light hydrocarbons.

Jet age . . . But these were half measures. They won't suffice in the jet age. For jet fuel is ready-made for static-ignited explosions. With the growing market for this fuel, the industry has strongly revived its interest in finding out just how trouble arises and what to do about it.

Three elements are necessary for a static-ignited explosion: Fuel, air, and a spark. Eliminate any one and the problem is licked. It can also be prevented by controlling air-fuel ratios in enclosed vapor spaces to limits outside the flammable range.

Gasoline has generally given little trouble because it gives too rich a mixture in the vapor space. Kerosine and burning oil generally result in too lean a mixture. But jet fuel shows just the right volatility of 2 to 3 psi. R.v.p. for a flammable mixture over the temperature range —10° to +80° F. Hence, the swelling record of explosions in the industry.

The problem is kept within reasonable bounds by a number of measures: Floating roof tanks to eliminate the vapor space, inert gas blanketing to reduce flammability, lower pumping rates, and subsurface filling to minimize static-generated sparks.

The over-all picture . . . What is needed is a thorough look at the entire picture, starting with the mechanism of static electricity generation. A good start on this study of theory is under way by Esso Research & Engineering Co. D. T. Rogers, J. P. McDermott, and J. C. Munday reported their findings at the API meeting.

When two dissimilar materials come into contact, an exchange of electrons takes place. One becomes positively charged, the other negatively charged. Re-exchange normally "relaxes" the static charge. But when the two charged elements are separated they become insulated from one another and the static charges remain.

This occurs in a number of instances in the handling of hydrocarbons. Friction with the walls of pipe or vessels promotes static buildup. Water or other contaminants in oil will cause ionization within the liquid itself.

These charged particles do not remain stationary. In grounded pipe and vessels the metal particles are neutralized. Water settles to the bottom of a tank. The remaining hydrocarbons with the same charge repel one another and tend to migrate to the liquid surface. There they build up sufficient voltage to jump the gap in the vapor space, and a spark results.

In laboratory pumping tests, Esso has established the relative tendencies of various hydrocarbon products to generate static electricity. Basic relationships between conductivity and static production, effect of flow rate, the role of contaminants, and several other fundamental aspects of this phenomenon contribute to better understanding and future control.

Pipeline flow . . . Another Esso Research team—W. M. Bustin, T. L. Culbertson, and C. E. Schleckser, Jr. —came up with a formula for computing electrical current generation in pipeline flow They have developed a probe which permits the measurement of electrostatic fields in a 10,000-gal. tank. Resistivities of a wide

History of petroleum engineering is reviewed by editorial board which is overseeing the monumental writing project. Chairman at head table is D. V. Carter, Magnolia Petroleum Co., Dallas.

range of commercial fuels were measured and reported.

With this basis in research, they offered several practical suggestions. The equation for pipeline charge generation led to the idea of a relaxation tank, or an enlarged pipe section where static charges could be neutralized. This device was recommended particularly in jet fuel handling systems, where the use of filters promotes static generation.

Carbon dioxide appears to be the best blanketing medium, they report. Their basic studies permitted a theoretical approach to the design of CO_2 systems checked in test runs.

A. Klinkenberg of N.V. De Bataafsche Petroleum Mij. first studied the case histories of static-induced explosions as a guide for commencing research on the subject. The project developed information on static generation by hydrocarbons in turbulent pipeline flow.

The work led to a study of conductivity of various petroleum products, or their ability to relax static charges. Crude oil, for example, has such a high conductivity, because of the presence of asphaltines, that it cannot accumulate static electricity and therefore is safe to handle.

Additives . . . The conductivity work then turned to evaluation of various additives which would increase the conductivity of products. In this search the Shell team made use of their company's earlier discovery of the "combination effect." Certain additives when used together give a higher conductivity than the sum of their separate effects.

Having determined the level of conductivity which included enough safety margin to assure sufficient reduction of static charge, they evaluated a number of additives.

Two additives used together do the job, according to Klinkenberg. A dosage of 0.7 lb. of concentrated solution of the mixed additives per 1,000 bbl. of liquid hydrocarbon increases conductivity to a level which will assure considerable safety margin.

The additives are a chromium salt of a mixture of C_{14}-C_{18} mono- and di-alkylated salicylic acids, and the calcium salt of di (2-ethylhexyl) sulfo succinic acid.

Radioisotopes . . . Another approach using a radioisotope appears to promise relief in small tanks. According to J. J. Conradi, J. R. Miller, and J. J. Skelly of Shell Oil Co., exposure of a charged liquid surface in a small cone-roof tank to beta rays emitted by strontium-90 ionizes the vapor space above it and provides a conductive path through which the static charge is dissipated.

Shell doesn't claim to have all the answers on this approach yet. But the laboratory experiments showed that a 0.1 curie source of strontium-90 and its daughter isotope yttrium-90 sufficed in a small tank.

Annual API banquet brings together the following pipeliners (starting at extreme left): L. E. Woods, Derby Refining Co., Wichita, Kans.; D. L. Rankin, Wyco Pipe Line Co., Denver; L. R. Dickinson, Trans-Northern Pipe Line Co., Toronto; Paul Reed, pipeline editor, The Oil and Gas Journal, Tulsa; J. W. Meehan, Derby Refining Co., Wichita; Walter J. Horstman, Plantation Pipe Line Co., Atlanta; John W. DeGroot, Tuscarora Pipe Line Co., Ltd., Harrisburg, Pa.; H. J. Holcomb, Socony Mobil Oil Co., Inc., Plainfield, N. J.; C. M. Brecheisen, Socony Mobil, Plainfield; and C. E. Main, also of Socony Mobil, Plainfield.

Research Needed

in getting more oil from reservoir, Thompson says. New advances predicted.

THE GREATEST HOPE for increasing domestic reserves of crude oil lies in advances in the study of reservoir control, Ernest O. Thompson, Texas Railroad Commissioner, told a Division of Production session.

"We stand on the threshold of knowledge that will advance petroleum engineering more in the next 25 years than all the progress we have made since the first petroleum engineer went to work at this branch of engineering," Thompson said.

Last year's closing of the Suez Canal and the forecasts of increasing demand for petroleum products demonstrate the need to maintain adequate domestic reserves, Thompson said. But he pointed out that drilling for oil and gas is going deeper and becoming more expensive and has fallen off this year.

Thompson attributed the decline of about 10 per cent under last year in the number of wells drilled so far in 1957 to wider spacing, tight money, and excessive imports. The imports problem, he said, apparently is being solved to the satisfaction of domestic producers and will tend to encourage drilling in the United States.

He predicted that by 1965 the U.S. will have to drill some 645,000 additional wells to keep reserves in the same proportion to demand as they are today.

But he added: "In addition to exploration for new reserves, we must consider the concept of obtaining greater recoveries of oil actually in place in the ground. In years past the primary recovery of oil has resulted in from 50 to 85 per cent of the oil being left in the ground.

Modern techniques, however, have increased the recoveries far in excess of 50 per cent. This has been accomplished by the injection of extraneous fluids from the reservoir to the well bore. These processes may be identified as water flooding, cycling, gas injection, and a newer technique of miscible-fluid displacement.

"This latter process, we have been told by the research people, can very nearly approach 100 per cent recovery of oil in place, and has been so demonstrated in the laboratory.

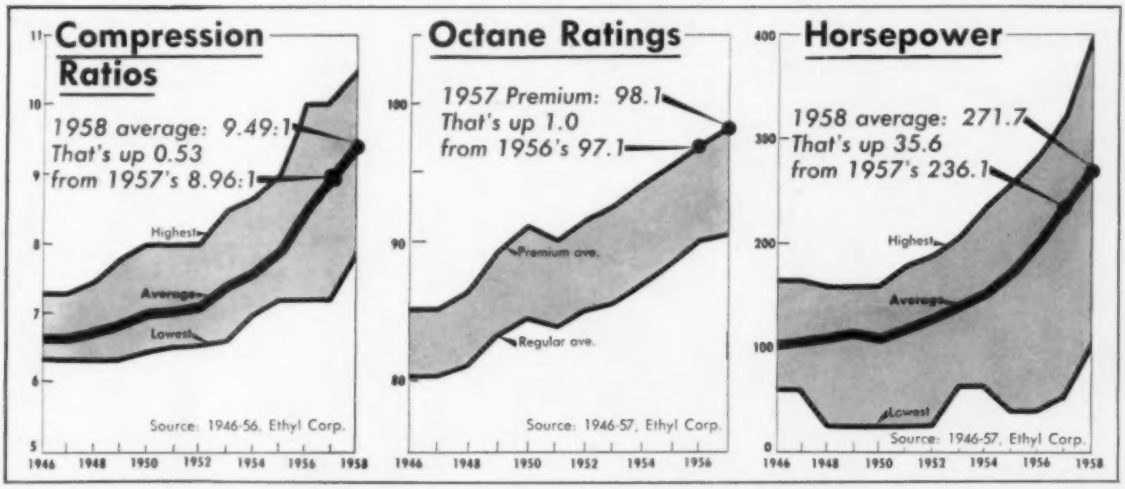
"These additional recovery techniques simply mean that we can expect to actually recover more oil in the future from reserves comparable to those discovered in the past."

the OIL AND GAS JOURNAL

November 18, 1957

1958 Cars: More Power, Better Gas

Detroit's new models are more demanding of the oil industry, and refiners are expected to keep pace with even higher octane fuel (see charts below). Difference between highest and lowest grades needed is increasing.



John P. O'Donnell
District Editor

AUTO MAKERS for 1958 have put out bigger, more powerful cars to take advantage of better gasoline quality provided by the oil industry.

Premium motor fuel is up one octane from a year ago—and Detroit has built its 1958 models with higher compression ratios, more horsepower, greater piston displacement, and added gadgetry. There are more models, too.

All this adds up to another year of emphasis on premium gasoline.

More significant than the fact that 1958 figures top those for 1957 in compression ratio, horsepower, and piston displacement is the fact that the gain is greater than it was in 1957 over 1956.

These bigger gains were made despite the fact that manufacturers are closer to the absolute maximum.

Here are the comparisons: Compression ratio—1958 over 1957 was 0.53, while 1957 over 1956 was 0.41. Horsepower—1958 over 1957 was 35.6 hp., while 1957 over 1956 was 29.9. Displacement—1958 over 1957 was 26.9 cu. in., while 1957 over 1956 was 13.2.

Compression story . . . Mercury, Edsel, and the top Pontiacs share the lead in compression ratios for 1958. All stand at 10.5 to 1.

The cast is almost totally different from the 1957 leaders—Buick, Cadillac, Lincoln, and Pontiac, all of them (11 models) at 10 to 1. The 1958 crop has about 30 models with compression ratios of 10 to 1 or better.

Mercury's Park Lane, equipped with three two-barrel carburetors, is the hottest "hot" car of 1958. It is the first to claim 400 hp. It has a 10.5 to 1 compression ratio, equaling the highest, and a piston displacement of 430 cu. in., equaled only by Edsel. By giving Mercury the higher horsepower, Ford Motor Co. now blankets the "hot" car field with the Mercury and the new Edsel.

The field that Mercury tops is a big one—bigger than ever. There were 50 models in 1957 and 70 in 1958. The new ones include the four Edsels, Chevrolet's Impala, Chrysler's 300-D, DeSoto's Adventurer, Dodge's D-500 and Super D-500, Mercury's Park Lane, Plymouth's Fury and Golden Commando, Studebaker's Scotsman and Silver Hawk, American Motors' Rebel, and Buick's Limited.

Plenty of variety . . . Not only are there a flock of new models, but there's a wide array of optionals.

Most of the optionals involve different carburetor arrangements. Chevrolet offers a good example of the variety. It has a single carburetor on its six-cylinder car but offers on eights a two-barrel carburetor, a four-barrel carburetor, a combination of three two-barrel carburetors, and fuel injection.

The effect of the different types of carburetor setups on horsepower is significant. For example, all Oldsmobile engines are of 10 to 1 compression ratio, and all have a 371-cu.-in. piston displacement. With a

Most '58 Models Pack More Punch Than Last Year

	Carburetor	Compression ratio 1958	Compression ratio 1957	Compression ratio Increase	Horsepower 1958	Horsepower 1957	Horsepower Increase	Displacement, cu. in. 1958	Displacement, cu. in. 1957	Displacement, cu. in. Increase
Buick:										
Special (Manual)	2-bbl.	8.0	8.0	...	...	...	...	364	364	...
Special (Dynaflow)	2-bbl.	9.5	9.5	...	250	250	...	364	364	...
Century, Super Roadmaster, Ltd.	4-bbl.	10.0	10.0	...	300	300	...	364	364	...
Cadillac:										
All except Eldorado	4-bbl.	10.25	10.0	0.25	310	300	10	365	365	...
Eldorado	2, 4-bbl.	10.25	10.0	0.25	335	325	10	365	365	...
Chevrolet:*										
6	Single	8.25	8.0	0.25	145	140	5	235	235	...
V-8	2-bbl.	8.5	8.0	0.5	185	185	...	283	283	...
V-8	4-bbl.	9.5	9.5	...	230	...	...	283	283	...
V-8	Fuel inj.	9.5	9.5	...	250	250	...	283	283	...
V-8	4-bbl.	9.5	9.5	...	250	...	...	348	283	65
V-8	3, 2-bbl.	9.5	9.5	...	280	270	10	348	283	65
Continental:										
Mark III	4-bbl.	10.0	10.0	...	375	300	75	430	368	62
Chrysler										
Windsor	2-bbl.	10.0	9.25	0.75	290	285	5	354	354	...
Saratoga	4-bbl.	10.0	9.25	0.75	310	295	15	354	354	...
New Yorker	4-bbl.	10.0	9.25	0.75	345	325	20	392	392	...
300-D	2, 4-bbl.	10.0	...	...	380	...	...	392	...	...
300-D	Fuel inj.	10.0	...	...	390	...	...	392	...	...
Imperial	4-bbl.	10.0	9.25	0.75	345	325	20	392	392	...
De Soto:										
Firesweep	2-bbl.	10.0	8.5	1.5	280	245	35	350	325	25
Firesweep	4-bbl.	10.0	8.5	1.5	295	260	35	350	325	25
Firedome	2-bbl.	10.0	9.25	0.75	295	270	25	361	341	20
Fireflite	4-bbl.	10.0	9.25	0.75	305	295	10	361	341	20
Adventurer	2, 4-bbl.	10.0	...	...	345	...	...	361	...	...
Adventurer	Fuel inj.	10.0	...	...	355	...	...	361	...	...
Dodge:										
Coronet 6	2-bbl.	8.0	8.0	...	138	138	...	230	230	...
Coronet Royal	2-bbl.	9.0	8.5	0.5	252	245	7	325	325	...
Coronet Royal	4-bbl.	9.0	8.5	0.5	265	245	20	325	325	...
Custom Royal	4-bbl.	10.0	8.5	1.5	295	260	35	350	325	25
D-500	4-bbl.	10.0	...	...	305	...	...	361	...	...
Super D-500	2, 4-bbl.	10.0	...	...	320	...	...	361	...	...
Super D-500	Fuel inj.	10.0	...	...	333	...	...	361	...	...
Edsel:										
Ranger, Pacer	4-bbl.	10.5	...	...	303	...	...	361	...	...
Corsair, Citation	4-bbl.	10.5	...	...	345	...	...	410	...	...

two-barrel carburetor this engine develops 265 hp., with a four-barrel carburetor 305 hp., and with a three two-barrel combination 312 hp.

Fuel injection is spreading out in 1958—but considerably less than was generally expected. For 1957 only Chevrolet and Pontiac had it, and only on an optional basis. Both still have it for 1958 but so do Plymouth, Dodge, DeSoto, and Chrysler. It's still optional and costs extra on all six makes. Injection is credited with adding 10 to 20 hp.

Supercharging . . . There's no progress on supercharging for 1958. It's still limited to Studebaker's Golden Hawk.

The Golden Hawk, with Studebaker's Scotsman, Champion, and Silver Hawk 6, share the lowest compression ratio in the new models, 7.8 to 1. However, the supercharged Golden Hawk, with a four-barrel carburetor, develops 275 hp., despite its low compression ratio. That's 50 hp. ahead of the comparable Silver Hawk 8 without supercharging.

Another development that did broaden in the 1958 models is air suspension. It's standard only on Cadillac's El Dorado Brougham and is optional on all other General Motors cars. Like power steering, power brakes, air conditioning, and the like, air suspension is another drain on the engine's power output.

To provide air suspension, an air compressor is mounted on the engine to keep tanks in the rear supplied with compressed air. The tanks supply the air to columns that replace the old coil springs. Buick says it can lift itself 5½ in. to get out of mud or snow.

Gasoline picture . . . The greater demand for power in the new cars means that gasoline quality must go up again to maintain its present position of advantage.

In late October Ethyl Corp. found the national average for premium was 98.1, exactly one octane above a year earlier. With compression ratios going up another half point, another full octane will be required. Therefore, it looks now like 99-octane premium will be average at this time next year.

This points up the variety of appetites the oil industry has to satisfy.

The Automobile Manufacturers Association says the life of a car now

	Carburetor	Compression ratio 1958	Compression ratio 1957	Compression ratio Increase	Horsepower 1958	Horsepower 1957	Horsepower Increase	Displacement, cu. in. 1958	Displacement, cu. in. 1957	Displacement, cu. in. Increase
Ford:										
All models 6	Single	8.6	8.6	...	145	144	1	223	223	...
Custom 300, Fairlane	2-bbl.	9.1	8.6	0.5	205	190	15	292	272	20
Fairlane 500, Wagons	2-bbl.	9.5	9.1	0.4	240	212	28	332	292	40
Fairlane 500, Wagons	4-bbl.	9.5	...	...	265	...	...	332	...	...
Fairlane 500, Wagons	4-bbl.	10.2	...	...	300	...	...	352	...	...
Lincoln:										
Premiere and Capri	4-bbl.	10.0	10.0	...	375	300	75	430	368	62
Mercury:										
Monterey	Econo.	10.5	9.75	0.75	312	255	57	383	312	71
Montclair	4-bbl.	10.5	9.75	0.75	330	290	40	383	368	15
Park Lane	4-bbl.	10.5	...	...	360	...	...	430	...	...
Optional in all	3, 2-bbl.	10.5	...	...	400	...	...	430	...	...
Oldsmobile:										
Dynamic 88	2-bbl.	10.0	9.5	0.5	265	277	—12†	371	371	...
Super 88	4-bbl.	10.0	9.5	0.5	305	277	28	371	371	...
98 Series	3, 2-bbl.	10.0	9.5	0.5	305	277	28	371	371	...
Packard:										
Hawk*	4-bbl.	7.8	7.8	...	275	275	...	289	289	...
Plymouth:										
Plaza, Savoy, Belvedere 6	Single	8.0	8.0	...	132	132	...	230	230	...
Plaza, Savoy, Belvedere V-8	2-bbl.	9.0	8.0	1.0	225	197	28	318	277	41
Plaza, Savoy, Belvedere V-8	4-bbl.	9.0	8.5	0.5	250	235	15	318	301	17
Fury	2, 4-bbl.	9.25	...	...	290	...	...	318	...	...
Golden Commando	2, 4-bbl.	10.0	...	...	305	...	...	350	...	...
Golden Commando	Fuel inj.	10.0	...	...	315	...	...	350	...	...
Pontiac:										
Chieftain, Super Chief	2-bbl.	8.6	8.5	0.1	240	227	13	370	347	23
Chieftain, Super Chief	4-bbl.	10.1	10.0	0.1	255	252	3	370	347	23
Star Chief, Bonneville	2-bbl.	8.6	...	...	270	...	...	370	...	...
Star Chief, Bonneville	4-bbl.	10.1	10.0	0.1	285	270	15	370	347	23
Optional, all models	3, 2-bbl.	10.5	...	...	300	...	...	370	...	...
Optional, all models	Fuel inj.	10.5	...	...	310	...	...	370	...	...
Rambler:										
Rambler 6	Single	8.7	8.25	0.45	127	125	2	195.6	195.6	...
Rambler, optional	2-bbl.	8.7	...	...	138	...	...	195.6	...	...
Rebel	4-bbl.	8.7	8.0	0.7	215	190	25	250	250	...
Ambassador	4-bbl.	9.7	...	...	270	...	...	327	...	...
Studebaker:										
Scots., Champ., Silver Hawk 6	Single	7.8	7.8	...	101	101	...	185.6	185.6	...
Commander, Provincial	2-bbl.	8.3	8.3	...	180	180	...	259.2	259.2	...
Commander, Provincial	4-bbl.	8.3	8.3	...	195	...	...	259.2	...	...
President, Silver Hawk 8	2-bbl.	8.3	...	...	210	...	...	289	...	...
President, Silver Hawk 8	4-bbl.	8.3	...	...	225	...	...	289	...	...
Golden Hawk (supercharged)	4-bbl.	7.8	7.8	...	275	275	...	289	289	...

*All engines available in all body series. †Horsepower of Oldsmobile's Dynamic 88 will decrease. This is the only 1958 model whose horsepower will be cut.

averages 12 years, or 110,000 miles. Twelve years ago compression ratios were as low as 6.3 to 1, compared with today's high of 10.5 to 1. That's a 4.2 difference.

What these figures mean is that a service station would have to dispense gasoline with a range of more than nine octanes to satisfy precisely the needs of all cars.

Not much economy . . . Taking the 1958 field as a whole, there is relatively little emphasis on economy. But there is one notable exception—the Oldsmobile 88.

The Olds 88's dual carburetor develops 265 hp. Last year all Oldsmobiles were rated at 277 hp. This is a drop of 12 hp., despite a 0.5 increase in compression ratio. Oldsmobile claims up to 20 per cent increase in economy.

Ford says all its models, except the 300-hp. Fairlane, will run on regular gasoline. Last year Ford recommended premium throughout.

Most other claims for economy rest with the six-cylinder versions of Plymouth, Chevrolet, Dodge, and Rambler.

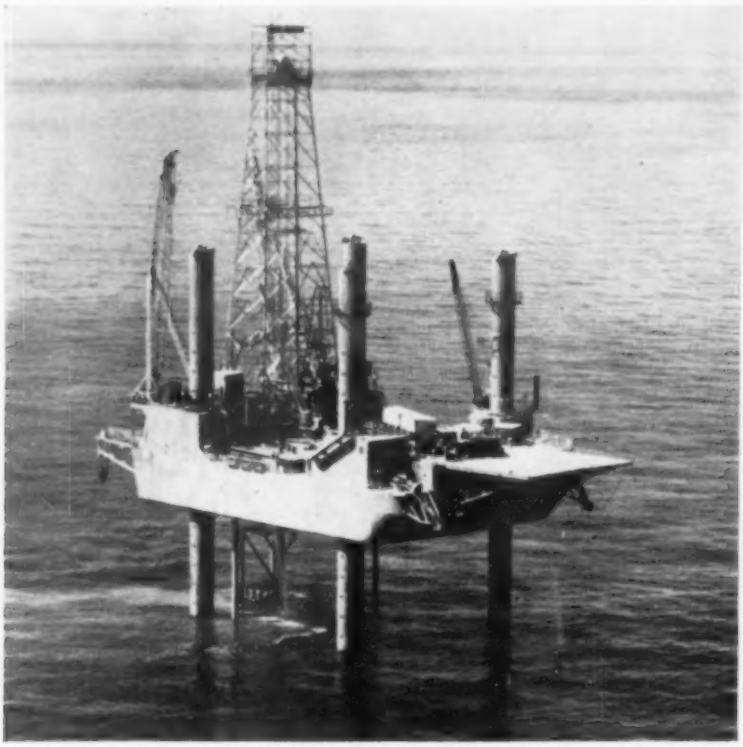
Sales outlook . . . The entrance of so many new models and options means that 1958 will be highly competitive.

And there is good reason to believe that sales may well run second only to 1955's all-time high. In fact, 1955 may contribute to it because, in that year, some 900,000 cars were bought on 32-month payment plans which terminate next year. Many 1955 buyers should be bright prospects.

Against this rosy prospect is price. Most of the new cars will cost more than the 1957 models.

Another growing factor in the competitive picture is the foreign car. Through the first 7 months of 1957 imports totaled 137,107 units, a tremendous percentage gain over the 56,240 brought in for the same months of 1956.

Most American manufacturers have foreign agencies or associates and are watching the field cautiously. Ford has said that when imports reach 5 per cent of the U. S. market, it will probably start manufacturing an economy car in this country.



Depth record for Mr. Gus II overshadowed when . . .

Piggy-Back Drilling Job

. . . is achieved by erecting a production platform under the drilling slot before offshore well is spudded.

A NEW DRILLING technique dreamed up by engineers of the CATC Group is stealing the spotlight from a new water-depth record set in offshore drilling.

The four-company combine has spudded the interesting test in 137 ft. of water. Location is in Block 70, West Delta area, about 25 miles west of the Southwest Pass of the Mississippi River.

Projected to 14,000 ft., the wildcat is being drilled by "Mr. Gus II," mobile platform owned by C. G. Glasscock Drilling Co.

Previous deep-water champion was on a Gulf Oil Corp.-Humble Oil & Refining Co. test. Their South Timbalier well in 118 ft. of water was the former record holder (OGJ, Sept. 23, p 74).

The setup . . . The piggy-back drilling feature was achieved like this:

Before the CATC test was spudded a wellhead platform was erected under the drilling slot in the deck of "Mr. Gus II." Drilling then was started through one of the legs of the tripod platform which serve as a protective structure for the conductor pipe.

If the well is a producer, "Mr. Gus II" will be backed off location, leaving the stationary structure as a production platform.

The three-legged platform was designed by Fares Hanna & Associates, Inc., Houston. The 126-ton structure was lifted from a barge and lowered into place by two cranes on the drilling barge without assistance of a derrick barge.

Rising 177 ft. high, the stationary platform rests on a base measuring about 45 by 50 ft. The triangle platform rising above the base is 18 ft. wide. Piling was driven through five jackets at the base of the structure rather than through its legs.

Two of the three legs are 30-in. pipe. The third leg, through which the conductor pipe is driven, is 34-in. pipe.

A triple deck has been designed to be placed above the present structure in event the well is completed as a producer. It would contain the christmas tree, fog horns, and helicopter-landing deck.

If a sizable field is discovered, later wells can be drilled from a large self-contained platform erected beside the present unit. In event of a dry hole, the protective platform may be salvaged by cutting the pilings just above the gulf floor or by blasting them off under the mud line.

Canadian Gas Ban

is unlikely, Manning says after visiting Diefenbaker

CALGARY.—Premier E. C. Manning of Alberta is convinced that exports of natural gas from the Prairie provinces will not be blocked.

Manning thus put a different interpretation than most have put on a statement made recently in Commons by Canada's Prime Minister John Diefenbaker. The prime minister said a government decision regarding gas exports would await a report from the Borden royal commission now studying energy and supply sources.

Diefenbaker made his comment in answer to a question by Social Credit party leader Solon Low. Social Credit leaders, along with many business interests, have been in the dark whether the new Progressive Conservative Government would honor the policy of the defeated Liberal Government to permit gas exports.

Interests affected by the decision would be Trans-Canada Pipe Line Co., western gas producers, and potential U. S. importers.

Premier Manning said he believes a broad interpretation should be put on Diefenbaker's remarks.

Manning observed, "I cannot conceive of the Government of Canada jeopardizing the continued progress and well being of one of the nation's most vital industries merely because a royal commission has been set up to look into the broad issues of power and energy.

"Particularly with the current decline in oil markets, it is vital to the continued growth and development of the industry and Alberta's economy that no artificial barriers be placed in the way of obtaining export markets for our surplus gas."

Manning said he talked recently in Ottawa with Diefenbaker. The prime minister then expressed a readiness to cooperate in any way possible. Diefenbaker suggested Manning prepare and submit to him summarized details dealing with the export problem.

Imports Action

taken by Texas lawmakers. Senate resolution calls for imports to be stockpiled.

RESOLUTIONS designed to discourage imports were making some headway in Austin last week during the closing days of the special session of the Texas Legislature.

The senate passed a resolution by Frank Owen, El Paso, calling on the Secretary of the Interior to consider the possibility of stockpiling imported crude oil underground. The senator contends such a move would remove the argument that Near East and Middle East oil should be drained out from under Russia's reach.

Meanwhile, Rep. John R. Lee urged house members to act immediately on three resolutions recently approved and sent to the house floor by the oil, gas, and mining committee.

The three would:

. . . Ask Sen. Lyndon Johnson to sponsor a "substantial" tariff on imported crude. The resolution originally suggested $1.50 a barrel.

. . . Request the State Board of Control not to buy oil products from any importing company or affiliate of such if products can be bought from others.

. . . Ask Texas Atty. Gen. Will Wilson to see if antitrust laws are being violated by "discriminatory purchasing" from Texas oil wells.

Lee pointed out the cut in Texas' crude-oil production is also cutting the state's tax revenue. He said increased production will solve this problem and that "none of us wants . . . . to pass a tax bill in order to provide money for appropriations which we have already passed."

Washington Test Has Trouble

THE OFFSET to Washington's first commercial oil well ran into trouble when Sunshine Mining Co. attempted to complete the 2 Medina in the Nye zone at 4,162-87 ft. Both the casing and liner collapsed during swabbing operations.

The well, which earlier showed oil and gas on a drill-stem test in a shallow interval at 2,590-2,602 ft., was plugged back to 3,804 ft. and perforated in the Ocean City zone at 3,016-36 ft. On a 2-hour test, the well flowed 30 bbl. of oil and then dried. Retesting was scheduled.

The 2 Medina is 840 ft. northwest of the 1 Medina, discovery in the Ocean City area of Grays Harbor, which is making 70 bbl. of oil daily through 8/64-in. choke from the Nye.

watching WASHINGTON

. . . with Bertram F. Linz

Canada frets over gas exports

NEW POLICIES on Canadian gas are in the making in both Washington and Ottawa.

The Federal Power Commission may have to set a new line on imports in the light of the freeze on export permits by the Canadian Government (see related story on opposite page).

In Ottawa, stiffer governmental controls on exports may be the end result of the study now being made by the Borden royal commission.

While that study is under way it may become impossible for any company to finance a new pipeline involving Canadian gas. First victim of this situation is Midwestern Gas Transmission Co.

Washington thinks the Borden commission may come up with a plan for a central Canadian agency to regulate the gas business, somewhat along the lines of our own FPC.

The agency would control interprovincial and export projects, possibly in oil as well as gas. It would pass on gas export projects from the standpoint of availability of supply, price, and domestic requirements.

There is no fear of a ban on exports. But the Diefenbaker government appears to see a danger of future excessive exports at the expense of Canada's own needs for gas.

Sputnik makes a better target

THANKS TO RUSSIA, the oil industry may be the subject of fewer congressional probes next year.

Sputniks and guided missiles make better political hay than does oil. Politics is always big business in Washington. But it's bigger when one party controls the administration and the other controls Congress, as now.

When this happens, congressmen are likely to be a little less interested in the matters they are probing than in showing up faults in the administration.

The recent inquiry into pipeline compliance with the 1941 consent decree is an instance. The main idea was to show slackness in enforcement by the Justice Department.

The Defense Department and Ike's military policies now are much better targets. Committees will be so busy with these next year that they will have little time for other less important matters.

The birds and the bison

YOU CAN'T PLEASE EVERYBODY. Interior Department officials are finding this out the hard way.

This is especially true when it comes to oil leases on wildlife lands.

Opening the refuge to oil men in late 1955 brought wild complaints from wildlife conservationists last year. They charged the department with ruining the refuges by opening them to leasing. A congressional probe followed. As a result, former Sec. Douglas McKay bowed to the demand that leasing be halted.

New rules offered by the department last month brought an outcry from oil men. This time, Sec. Fred A. Seaton is on the firing line. His order would ban leasing except to protect against drainage or on big ranges where leasing wouldn't interfere with the home life of the bison and bear.

Oil men argue that the ban isn't needed. They point out that some refuges have been leased for years, and the birds and fish are in better shape than ever.

It's a knotty problem. The department probably will call a hearing at which conservationists and oil men can fight it out. Whatever the result, it wouldn't please everybody.

Four Experts Look at Future Oil Finding

What they say:

1. The Middle East, Sahara Desert, and the U. S. tidelands off Louisiana and California are the most promising areas.
2. There are a lot of fields to be found from information on hand.
3. More oil can be found by better using seismic data. And running seismic data through an IBM can turn up some good prospects.
4. Early drilling is a trend in oil hunting today.

Members of the panel:

W. Dow Hamm, general manager of foreign and domestic exploration for Atlantic Refining Co.

Eugene McDermott, board chairman of Texas Instruments, Inc.

Henry Cortes, vice president and director in charge of research and coordination of offshore operations for Magnolia Petroleum Co.

John P. Woods, geophysical laboratory director for Atlantic Refining Co.

ONE OF THE HIGHLIGHTS of the twenty-seventh annual meeting of the Society of Exploration Geophysicists in Dallas last week was a panel discussion on "Finding Oil Tomorrow."

Following are some of the pertinent questions and answers. Maurice Tripp, Tripp Research Corp., Dallas, served as moderator.

Q. What areas offer best opportunities for finding new oil?

A. Hamm: Opportunities abroad appear definitely more attractive than those at home. Probably the best area for finding big new oil still lies in the Middle East—it's far from being fully explored.

A. Woods: Foreign opportunities do look best. For my part, I think it quite possible that production in the Sahara Desert area within a relatively few years may rival that from the Middle East.

Q. Where are the best bets at home?

A. Cortes: I feel that our offshore areas offer the most promise—especially the Louisiana and California tidelands areas. Today the tidelands produce 3 per cent of total U.S. oil output. It's hard to forecast now how much oil the tidelands will ultimately furnish. Some estimates place ultimate reserves as high as 20 billion barrels.

Economics will determine how fast this oil will be found and produced. The only relatively cheap operation offshore is seismic prospecting. Everything else is tremendously expensive. Costs run two to five times higher than on land. Too, recovery of invested capital is painfully slow. So far, industry has spent all-told about $2 billion and produced only about $400,000,000 worth of oil.

I think it will soon be possible to drill offshore in water depths of up to 1,000 ft., but here again economics will decide when.

A. Woods: I am both optimistic and pessimistic about the oil-finding future in the U.S. I think we are going to find it, but it certainly won't be easy. Best prospects appear to be deeper drilling, much more complete exploration in older areas, and exploring the few remaining semivirgin areas including Alaska, Canada, Utah, etc.

I personally think that we'll find a great number of large pools in the 20,000 to 25,000 ft. depth range within the next few years.

One of today's big exploration puzzles has been the poor showing off the Texas Coast. It has me mystified. Geological conditions are favorable. Perhaps we're not going deep enough.

Q. Speaking of big offshore reserves, why is it that offshore wells are being completed at 200-300 bbl. daily production rates while wells in the Middle East commonly potential for around 5,000 to 10,000 bbl. daily?

A. Hamm: Well, the average offshore well is completed flowing through a small-size choke. If we were to run them loose, many probably would flow as heavily as the prolific Middle East wells.

The real significance of our offshore production is the tremendous reserve it gives us. This incidentally, is a big safety factor nationally, and a good piece of insurance in case of emergency.

Q. What about our exploration philosophy? Are we using our manpower and present equipment as effectively as we can?

A. McDermott: We're not only failing to use it effectively, we're not even collecting it properly. I'm referring to seismic data. In many instances, it is badly distorted and hard to interpret and use.

I think we're not making enough use of magnetic recording and central office data handling processes. We have within our grasp now IBM treatment of seismic data that can eliminate much of the human errors in interpreting seismic records. With such techniques, we can run seismic data through machines and come out with usable cross-sections at the moment. This is a costly method and needs refining, but it holds great promise.

A. Hamm: The amount of data available to the oil finder is staggering. We have about 1,600,000 holes that have been drilled in the U. S. The sad part of this is that no operator is making use of all the information these holes provide.

A. Woods: That's true. I'll wager there isn't a company who hasn't had an oil field hidden in its files for 5 or 6 years, then watched some other company come along and discover it.

Q. If you were going into a new province, how would you explore it?

A. Woods: I would high-grade my exploration methods, using the cheapest and quickest first. I'm a geophysicist, but this is how I'd do it.

First send in geologists for preliminary surface work, then drill a hole to find out how much and what kind of geologic section is present. Early drilling appears to becoming an industry trend. For instance, in the Sahara a slim-hole test drilled for stratigraphic information found one of the significant oil fields there.

A. McDermott: It would depend a lot on the area. But, generally, I believe I would start with airborne magnetics and perhaps photogeology. This is a relatively cheap operation and can be done quickly. Then I could decide what to do next.

Q. Seismic work has been the oil-finding backbone in recent years. Are there any other methods—either new ones or old ones that haven't been fully exploited—that we can use to find the oil we will have to find in the future?

A. McDermott: I think aerial-color photography offers a great deal of promise. It's costly now, but it would get cheaper with increased use. Combined magnetic and electrical surveys can be very useful in regional work. Cagniard's method of electrical surveying can map basement topography and give a unique solution to depth determination, also locate faults accurately.

A. Woods: The electrical-profiling methods have never been fully exploited. It was largely an accident that the refraction-seismic method rather than the electrical profile was used to find the early Gulf Coast salt domes. The electrical method was developed earlier. Its instrumentation is more simple, and it is cheaper.

Temperature surveys, I think, could be much more valuable in finding oil and have been largely neglected, too.

A. Hamm: I still think one of the greatest possibilities for finding lots more new oil lies in better interpretation of seismic records—especially in areas such as the Gulf Coast. We can do a much better job of locating faults and strat traps just by improving seismic interpretation.

A. McDermott: I agree with Dow. I think there is a lot of room for better interpretation, better handling, and better storing of seismic data. I feel that refinement of the seismograph itself, however, is now reaching the point of diminishing returns. It needs to be supplemented with other techniques to make it more effective.

Processing briefs

Tires of the future may be a composite of specialized synthetic rubbers. That's the prediction of Dr. William J. Sparks, scientific advisor to Esso Research & Engineering Co., and co-inventor of butyl. Sparks told the Instituto di Chimical Industriale in Milan, Italy, last week that synthetic rubbers will be tailor-made for each vital part of the tire, such as treads, sidewalls, beads, and plies.

Jefferson Lake Sulphur Co.'s new 300-ton sulfur recovery plant is now on stream near Fort St. John, B. C. The $1,800,000 plant extracted hydrogen sulfide from natural gas processed by Pacific Petroleums, Ltd., at Peace River field. Within 5 years, Jefferson Lake plans to expand the plant to produce 500 to 600 tons of elemental sulfur daily. The product will find a market in Canada's pulp and paper industry.

North Star Oil, Ltd., is calling for bids for a proposed catalytic reforming unit at the company's new 11,000-bbl. refinery at St. Boniface, Man. The unit will cost an estimated $1,500,000.

Pontiac Refining Corp. has awarded three contracts totaling about $1,500,000 to the Fluor Corp., Ltd. One calls for redesign and modification of the No. 2 crude unit at Pontiac's Corpus Christi refinery. Another calls for design and construction of a 5,000-bbl. Unifining unit at Corpus Christi. The third contract is for a study of the firm's gas-recovery plant with a view to modifying it to handle refinery-gas streams now going to fuel gas.

Cities Service Oil Co. has bought Atlanta Gas Co.'s natural-gasoline plant at Chico, Tex., 60 miles northwest of Fort Worth. The plant processes 12,000 M.c.f. of gas daily from Alvord, Miles-Jackson, and Caughlin fields. Product output is 33,000 gal. daily.

Consumers' Cooperative Refineries, Ltd., will install a 3,000-bbl. delayed coker at its 16,000-bbl. refinery at Regina, Sask. Charging a 15 per cent residual crude fraction, the unit will produce about 145 tons of coke daily, which will be used by the aluminum industry in British Columbia.

Fluor Corp. of Canada, Ltd., has the contract for the new unit, which was engineered by Universal Oil Products Co. Completion is scheduled late next year.

One of the largest catalytic reforming units in the world is being installed by Esso Standard Oil Co. at the Baton Rouge, La., refinery.

The new 27,000-bbl. Powerformer is part of a $46,000,000 expansion program at the huge 355,000-bbl. plant. The Powerformer will use a new catalyst developed by Esso Research & Engineering Co.

Allied Chemical & Dye Corp. will build a sulfuric acid plant at Anacortes, Wash. It will adjoin Shell Oil Co.'s refinery and the refinery being built by The Texas Co. The plant will include hydrogen sulfide recovery facilities using the refineries' sludge and waste gases as its charge stock. The sulfuric acid will probably be used in alkylation units being built at both refineries.

Standard Oil Co. of California has started a program to boost cat reforming capacity at two of its West Coast refineries. Construction is under way on a 22,000-bbl. reformer at Richmond, and preliminary work has been completed for a 5,500-bbl. unit at Bakersfield. Bechtel Corp. has the engineering and construction contracts on both units. They are slated for completion next summer.

Shell Oil Co. has developed a new high-temperature grease which will stand up under 1×10^9 roentgens of gamma radiation. It's designed for use in nuclear power plants.

A new 5,000-bbl. Unifining unit is on stream at Rock Island Refining Corp.'s 14,000-bbl. refinery at Indianapolis. The company has also increased capacity of the plant's Platformer from 2,400 bbl. to 3,000 bbl. daily. The refinery's older 300-bbl. Unifining unit has been converted to production of specialty naphthas. All three of the units were designed and licensed by Universal Oil Products Co.

Amoco Chemicals Corp. entered the solid propellant field last week with initial production of starter cartridges for jet aircraft engines at Seymour, Ind. The entire output is slated for the Air Force under a $3,412,593 contract closed last March. Later, Amoco expects to fill other uses for the smokeless, low-cost propellant.

Tideland Decision Nears

. . . for five Gulf Coast states. Justice Department asks Supreme Court to rule on Texas claim for 3-league limit.

SOMETIME next year, the Supreme Court will decide whether the term "historic boundary" has any meaning in defining the seaward limits of Texas, Louisiana, and Florida.

The Justice Department has filed an amended complaint in the suit filed against Louisiana in 1955. This clears the way for a blanket decision covering all five Gulf Coast states.

Since Texas was named a party to the suit, the question of the meaning of "historic boundary" comes squarely before the court. Texas, which came into the union as an independent nation, claims a 3-league limit. The traditional limitation is 3 miles.

Texas bases its 3-league claim on certain treaties and statutes made before and after its admission to the union.

The Justice Department wants the court to decide if these treaties and statutes are controlling, or if the traditional 3-mile limit is controlling.

The department also wants to know if the Submerged Lands Act confirms any state claims to boundaries more than 3 miles in the Gulf of Mexico, such as Texas' 3-league claim.

What's behind it . . . The Louisiana suit was broadened to cover all the gulf states after Texas officials ask the court to decide the case in a way that would not prejudice the Texas claim.

Last summer the court invited other coastal states to enter the case. If the other states refused to come into the case, the court said the Government should bring them in.

Alabama was the only state to enter voluntarily. Justice department officials talked with Texas authorities, apparently in an effort to induce Texas to enter the case. Their refusal to do so is indicated in the new complaint which names all the states as respondents.

The history of the tidelands dispute, as given by the department, hints at disagreement between Eisenhower's policies in 1952-53 and the policy being followed by the attorney general.

Eisenhower repeatedly referred to the "historic boundary." He never said any state should have anything less. He did say it should have nothing more.

The department's position, however, has been that no state can have a seaward boundary beyond that of the nation—3 miles.

In an address at Houston in October 1952, Eisenhower said that in 1845 the U. S. Senate "decided that the public lands of Texas were not worth $10 million."

"That was the public debt of the Republic of Texas when Texas was annexed to the union," he explained. "So the United States said to Texas: 'Keep your debts, and keep your lands. We don't want either.'

"And so the State of Texas paid off the $10-million debt of the republic. It kept its 200-million acres of lands, including the submerged area extending 3 marine leagues seaward into the Gulf of Mexico."

As President, Eisenhower again stated his views the following April when the submerged-lands bill was pending in Congress:

"It has never been my belief that the several states should have any title to lands beyond historical boundaries on the Continental Shelf."

Department officials pointed out that former Atty. Gen. Herbert Brownell, Jr., urged Congress to draw "an actual line on a map" to mark the boundaries of the tidelines areas it was returning to the states.

"Congress chose instead to actually grant to each state title to and ownership of the submerged land within the state's historic boundaries, wherever they might be," it was explained. "It is that provision which has made the present litigation necessary."

The Government contends that "under international law no state or nation can have a boundary farther out than the traditional 3-mile limit."

Beyond that limit the federal Government asserts certain rights, such as enforcement of customs and sanitary regulations and control of exploitation of resources of the Continetal Shelf, but does not assert title or ownership.

New England Lines Planned

PLANS to build four products lines in New England have been unveiled by Conn-Mass Pipe Line, Inc., a newly organized company.

Bids have been asked on a 62.2-mile, 8-in. line from New Haven, Conn., to Springfield, Mass., the first of two lines planned for construction next year. The second will be an 88.4-mile, 8-in. line from Boston to Springfield.

The largest of the projects is scheduled for 1959. This is a 132.5-mile, 16-in. line from Linden, N. J., to Hartford, Conn. A 38-mile, 6-in. line from Waltham, Mass., to Fitchburg, Mass., also is planned in 1959.

Three pump stations are planned: a 1,500-hp. station at New Haven terminal and a 2,400-hp. station at Waltham terminal, both next year, and a 3,100-hp. station in 1959 at Tremley Point terminal, N. J.

Water-Flood Ruling

permits top production in test case in New Mexico. More requests expected.

OIL COMPANIES favoring capacity allowables for water-flood wells gained a precedent-setting victory last week before the New Mexico Oil Conservation Commission.

The commission voted unanimously to grant capacity allowables for 12 wells in the Caprock-Queen pool in Lea County, southeastern New Mexico. The order was the first on a water-flood development in New Mexico.

Graridge Corp., owned by the Street interests of Graham, Tex., filed the controversial application, which was supported and opposed by many of the nation's top oil producers. Scores of oil men operating in New Mexico sat in on the commission hearing that preceded last week's order.

Dan Nutter, engineer for the commission, said Graridge was the first company to make a "real effort" to obtain a capacity production permit on a water-flooding project.

The new order becomes effective December 1, although the commission retains jurisdiction and has authority to amend or revoke all or part of the order at any time.

A. L. Porter, member and executive director of the commission, predicted similar applications will be made for other water-flood projects in the Caprock pool. Operators owning some 600 wells in the pool recently discussed such plans at a meeting in Midland, Tex.

During hearings on the issue, experts argued pro and con on whether secondary-recovery floods deserve special treatment. Humble Oil & Refining Co.'s experts said "no," while those for Graridge cited case histories in which they claimed production is damaged when a low injection rate is adopted (OGJ, Nov. 11, p. 124).

First Dakota Units

approved by state. Scoria and Bear Den pools will be operated by Amerada.

AMERADA PETROLEUM CORP. will be the operator of North Dakota's first unitized oil fields.

The state industrial commission has approved unitization of Scoria field in Billings County and Bear Den-Madison field in McKenzie County. Both pools were discovered by Amerada early in October, and no offsets have been staked yet.

The Scoria unit takes in 4,454 acres, of which 3,733 acres are held by Amerada. Other leases are held by Pan American Petroleum Corp., Lario Oil & Gas Co., and Northern Pacific Railroad.

The Bear Den unit covers 2,640 acres, with Amerada holding more than half the leases. Other lease holders are Sun Oil Co., Pan American, and N. B. Hunt.

Both units required approval of the U. S. Geological Survey, since more than half the land is owned by the federal Government.

Lease holders of the Bear Den unit will participate in new wells on a fixed percentage basis, while participation in Scoria operations will be determined as development proceeds. There is no regular spacing pattern for either area.

The 1 Scoria Unit found production in both the Heath sand at about 8,000 ft., and the Madison lime at about 9,200 ft. Nearest production is 4 miles east at Fryburg pool.

The 1 Bear Den Unit found Madison lime production at about 9,600 ft. The new field is the southernmost pool in the Nesson anticline and is 5 miles east of production in Craff field.

High Court Clears Companies

SEATTLE.—Seven West Coast oil companies won a major court victory when the United States Court of Appeals unanimously reversed a previous conviction that they had conspired to close down a Seattle gas station operator.

The suit was filed 5 years ago by George F. Moore. He charged the seven companies with a conspiracy which eventually put him out of business. A federal court jury found the companies guilty.

The companies involved were Standard Oil Co. of California, Richfield Oil Corp., Union Oil Co. of California, Tidewater Oil Co., Shell Oil Co., The Texas Co., and General Petroleum Corp.

Pipeline briefs

Ralph K. Paine, manager of the pipeline department of Standard Oil Co. of California, is the new president of the Pipe Liners Club. He succeeds J. H. Wood, Jr., vice president of Atlantic Pipe Line Co. Paine was vice president of the club last year.

The Pipe Line Contractors Association plans to conduct a welding school next year to remedy the shortage of welders which hampered contractors during the 1957 construction season. The school will be operated in conjunction with the University of Texas extension service which will provide administrative personnel. The school, to start in January, will be located at Kilgore, Tex. The contractors association will supply instructors and the school will charge no fee.

Pacific Northwest Pipeline Corp. completed a 64-mile, 6-in. lateral from its system at Spokane, Wash., to Kellogg, Idaho. Hallmac Construction Co. completed the project last week. The line will supply gas to industrial and residential customers in the Kellogg area. A 35-mile, 4 and 6-in. lateral from the system in Snohomish County, Washington, to Grotto, Wash., was completed by Midwestern Constructors, Inc. The line will supply a cement plant.

New developments in positive-displacement metering in products pipelining and increasing acceptance for crude-oil measurement were reported to the pipeline operating section of the API. Development has centered primarily on new means of meter proving and transmission of meter registration to consoles in control rooms.

P.D. meters are being used in two or three Texas fields for official measurement of runs from the producer's tank into the gathering system for automatic custody transfer. Similar operations are becoming more widespread in other states and in Canada. On the Texas New Mexico Pipe Line Co. system, now being built from Four Corners to Jal, N. M., delivery by producers will be by automatic custody transfer with P.D. meters on virtually all leases.

Shell Pipe Line Corp. has taken the first step toward construction of a 120-mile crude line from the Delta area of South Louisiana to the New Orleans refining area. Contract for right-of-way acquisition has been let to Coates Field Service, Inc., which will also handle settlement of damage claims.

The line will be 11 miles of 8-in., 2.5 miles of 10-in., 10 miles of 12-in., 36.5 miles of 16-in., and 60 miles of 20-in. Completion is scheduled for September 1958.

The FPC called off legal action against Union Producing Co. after the firm announced it would comply with the filing of rate schedules and would apply for sales certificates.

Last month the FPC threatened to file court suit and refer the matter to the attorney general for action under the Natural Gas Act. Both Union and its affiliated United Gas Pipe Line Co. had contested the FPC's authority over their operations.

Cities Service Pipe Line Co., has completed a 30-mile, 6-in. ethylene line from Lake Charles, La., location of the Petroleum Chemicals, Inc., plant, to Orange, Tex. L. E. Farley, Inc., Houston, Tex., constructed the line, which will supply feed stock to a petrochemical plant.

Olin Gas Transmission Corp. is laying a 20-mile, 10-in. line and a Mississippi River crossing near White Castle, La. The river crossing will be three 8-in. lines. The job is contracted to Houston Contracting Co. under supervision of A. J. Slovack and R. E. Thornton, superintendents.

American Louisiana Pipe Line Co. is laying 7 miles of 16-in. and 5 miles of 12-in. gas line between Second Bayou, La., and Cameron, La. The job, contracted to Ford, Bacon & Davis Construction Corp., will be completed next month.

Union Gas Co. of Canada, Ltd., will complete its 142-mile, 26-in. pipeline from Dawn Township to Trafalgar Township in Ontario, December 1. Canadian Bechtel, Ltd., is handling the project. Union has extensive underground storage at Dawn.

Skelly Oil Co. has contracted a 50-mile, 12-in. crude pipeline project in Kansas to Groninger & King, Pampa, Tex. Construction is under way on the line between Cunningham and Burton, Kans. The new line will replace a 6 and 8-in. system which has been partially looped. Skelly has completed a 40-mile, 8-in. extension of its gathering system into southern Kiowa County, Kansas, to Nichols field.

Latest Recovery Method

. . . gets approval from Texas commission. Atlantic to use LPG, gas, water to sweep Slaughter lease next summer.

THE TEXAS RAILROAD Commission flashed a go sign in Austin last week for the latest in miscible-phase recovery projects.

Atlantic Refining Co. now has the way cleared for a full-scale recovery program calling for injection first of propane, then gas, then water into San Andres pay under the 1,247-acre H. T. Boyd lease in Slaughter field.

The company expects to recover about 16,000,000 bbl. of extra oil over that amount producible by primary means.

Atlantic figures original oil in place in the San Andres under the lease at about 32,000,000 bbl. and total primary recovery at only 20 per cent of this volume. The pay already has produced about 4,900,000 bbl. or about 15 per cent of original oil.

This new type of secondary-recovery program, Atlantic thinks, will hike total oil take to about 62 per cent—or about 8 per cent more than could be produced by ordinary water flooding.

The percentage would be much higher except that Atlantic must deal with a lease surrounded by other leases rather than an entire reservoir. Migration of oil off the lease due to the program's high pressures will be the big reason for a lower percentage of recovery.

Summer start planned . . . Atlantic hopes to have the Boyd program in full operation by next June. Between now and then the company will be busy rounding up the necessary supplies of propane, gas, and water, and running the final engineering calculations.

Three of the lease's 35 wells will be converted to injection service. About 255,000 bbl. of propane will be injected during the first 6 to 8 months, followed by about 3.4 billion cubic feet of gas over the next 2½ to 3 years. Then plans call for injection of about 6,000 bbl. of water daily.

Pressure in the San Andres in the Boyd area is down to about 640 psi., and the pay is about 75 per cent depleted. When the propane is injected and gas input started, Atlantic says it will have to maintain a pressure of about 1,300 psi. at the gas-propane interface in order to obtain the miscible effect. This means surface injection pressure of about 2,000 psi. will be needed.

With such pressure, oil will be forced toward surrounding leases where pressure is much lower. Thus Atlantic engineers think they can afford to maintain a miscible front only until it has swept 34 to 35 per cent of the pay before too much oil would begin to migrate.

When that point is reached, Atlantic plans to let the pressure drop back to a level comparable to that of neighboring leases and carry on with a conventional flood.

Water important . . . Injection of the water after the gas, Atlantic contends, is essential to improve the areal sweep of the slug process.

The company says its technicians have not yet been able to find a reservoir where a propane-gas slug drive alone would be economically feasible in comparison with a water flood.

Though the miscible slug will sweep clean wherever it reaches, it won't touch a considerable part of the total reservoir rock due to poor areal sweep efficiency, Atlantic thinks. Thus, ultimate recovery from the process would be little if any better than that of a flood.

Ideally, Atlantic figures, water and gas should be injected simultaneously behind the gas band to get the most oil out. But this wasn't considered feasible at the Boyd project due to the oil-migration problem.

Where this is possible, such dual-fluid injection would improve the slug's sweep in two ways: 1. Lowering the pay zone's relative permeability to gas by interfering with the gas flow. 2. Increasing the average viscosity of the flowing system pushing the oil (OGJ, July 15, p. 59).

Higher allowables . . . Atlantic had asked the commission for higher allowables up to a probable lease maximum of 2,200 to 2,800 bbl. daily to help prevent excess migration of oil across lease lines.

The commission went along up to a point, granting Atlantic a top lease allowable equal to the present top allowable unpenalized by high gas-oil ratios. If an allowable higher than this should be needed in the future, the commission said it would hold a hearing on request from Atlantic.

This action was in line with recommendations of other Slaughter producers including Pan American Petroleum Corp., The Texas Co., and Humble Oil & Refining Co.

New rules for the project area also include credit against gas-oil ratios for the propane, gas, and water injected. Atlantic may transfer allowables of the input wells, after tests, to other producing wells on the lease.

Fish Halts Record Texas Hole

PAN AMERICAN Petroleum Corp. last week decided against trying to make more hole at the world's second deepest well.

The company left a 1,600-ft. fish on bottom of the 1-CS University and backed up the hole to test the Wolfcamp and Pennsylvanian zones.

The venture, 13 miles southeast of Fort Stockton in Pecos County, Texas, reached a total depth of 21,687 ft. This was 2,627 ft. deeper than the previous record depth in Texas and 205 ft. below the world's previous second deepest hole—a duster drilled to 21,482 ft. by Ohio Oil Co. in California's Paloma field in 1955.

Top of the fish in the Pecos County deep test was at 20,078 ft. It included drill pipe, bit, and several drill collars. Pan Am labored for more than a week — first fruitlessly to free drill pipe stuck near total depth, then to recover as much of the drill string as possible.

A short time earlier, the drilling contract was amended to carry the hole to 22,000 ft., only 570 ft. short of the world record. The company was deliberating whether to continue drilling when pipe stuck.

The well originally was set up as a test to the Ellenburger or to 16,000 ft., whichever came first. Pan Am later shifted to the shallower Devonian as its objective when it appeared the Ellenburger likely was out of reach.

Contributing to the depth was an unusually thick section of Barnett shale of Mississippian age. The 1 University entered the shale at about 18,880 ft. and was still in it at total depth.

Pan Am last week was preparing to run tests of the Strawn at about 18,500 ft. in open hole. It then will back up the hole to about 15,000 ft. and perforate 7⅞-in. casing to test the Wolfcamp formation.

Twin Strikes In Venezuela

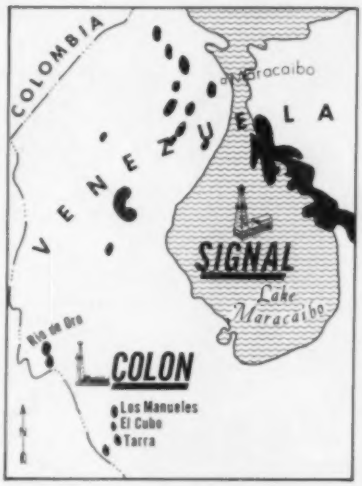
. . . may mean a new oil-producing region near Colombian border, brighter outlook for lake acreage (see map).

THE LATEST Venezuelan developments involved these two groups:

. . . Colon Development Co., Ltd., a Royal Dutch-Shell subsidiary, brought in a deep discovery near the Colombian border that tested at the rate of 2,000 bbl. daily.

. . . Signal Oil & Gas Co. of Venezuela confirmed a major discovery on the 27,600-acre Lake Maracaibo concession it holds jointly with Pure, Hancock, and Ohio Standard. It flowed at rate of 2,400 bbl. daily.

Both strikes will have major significance if further testing bears out early hopes.



The border strike . . . Colon Development's wildcat puts the spotlight on a possible new Venezuelan area of major production.

The company called its CR.4 in Rosario a preliminary success. The 2,000-bbl.-daily rate of flow was achieved on a short test of Cretaceous from 14,118 to 14,197 ft. Crude was 39°-gravity with a low gas-oil ratio.

The wildcat is about 50 miles due west of the southwestern tip of Lake Maracaibo. It is 10 miles from the Colombian border and a mile north of the Rio de Oro.

Colon is drilling ahead at 14,546 ft. It plans to evaluate as much of the Cretaceous interval as safety of the hole will permit.

Other production in the region is much shallower. Los Manueles and El Cuba-Las Cruces, 27 and 30 miles south and east, produce a total of about 5,000 bbl. daily, mostly on pump. Their production is from Eocene, ranging in depth from 300 to 8,000 ft. Tarra field, a few miles south of El Cubo, produces more than 14,000 bbl. daily from flowing wells. Its pay zones are Paleocene and Cretaceous from 4,250 to 9,800 ft.

Across the border, Colombia's Tibu field lies about 30 miles to the south-southwest. It produces about 20,000 bbl. daily from several intervals ranging from 786 to 9,700 ft.

Colon drilled three other wells in its current program on Rosario block. CR.3 was suspended last year at 13,784 ft. It had been located on the basis of seismic work. The company now plans a wildcat on its Rio de Oro block to the west. A 25-mile road from Rosario into the area is under construction.

In the lake . . . Glowing reports on Signal's discovery resulted from a 3-hour test of the interval from 12,113-83 ft.

The well, 2X Centro, flowed 40°-gravity crude through a ⅝-in. choke at rate of 2,400 bbl. daily. After perforating, the well changed from mud to water and cleaned up flowing in 2 hours.

Signal plans to complete the well and then move the platform to a site a mile northwest. Three other drilling platforms are ready to join exploration work on the lease.

The discovery well is the second test drilled on the concession. The first, located about 4 miles northeast of the discovery, was drilled to 9,470 ft. It was capped without testing. Signal now reports that additional geological work will be undertaken on it to determine whether to reenter and complete testing.

The discovery well brightens outlook for the area in the central portion of the lake. The group reported that in addition to about 70 ft. of producing zone at the 12,000-ft. level about 350 ft. of additional zones were encountered at shallower depths. Excellent production at the greater depth, however, eliminated testing of the shallow zones now.

Nearest production to the Signal group's well is 7 miles away on a block owned by Creole Petroleum Corp. Creole has production on a thin strip of acreage to the east of Block 4 and also is wildcatting in the northern part of Block 5 to the south.

Costa Rican Test

spudded by Union. It'll be in area of two near misses

UNION OIL CO. of California has spudded in another wildcat on its huge concession in Costa Rica. This latest effort will test the Victoria dome, near Puerto Limon, about 30 miles northwest of the Cocoles area.

It was in the Cocoles area, on the Costa Rica - Panama border, where Union almost gave this small Central American country its first commercial well last year. The well, 2 Cocoles, tested up to 7,000 bbl. daily of 46°-gravity crude on a formation test of a 72-ft. zone at around 5,000 ft. However, it quickly went to salt water and was abandoned.

Union had a near miss with 1 Cocoles in the same region, but it also had salt-water trouble. Before it was abandoned, Union found 114 ft. of saturated limestone at 5,450 ft. Both of these tests, Union's fourth and fifth tries in Costa Rica, were located near Puerto Viejo, 16 miles inland from the Caribbean Coast.

Union holds concessions covering 3,500,000 acres in Costa Rica. However, its agreement with the country calls for it to turn back all but 370,650 acres if production is found.

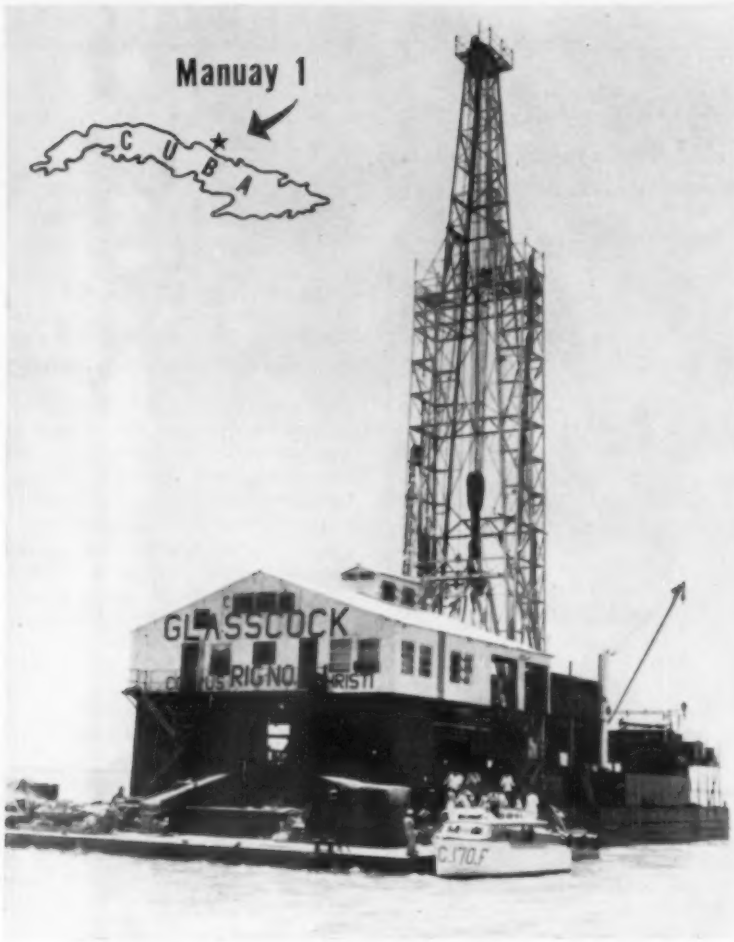
Shell Refinery Enlarged

CIA. SHELL DE VENEZUELA has opened the first alkylation and catalytic cracking units to go on stream in Venezuela.

Luongo Cabello, Minister of Mines and Hydrocarbons, dedicated the units in ceremonies at Cardon refinery. The cat cracker is rated at 33,000 bbl. daily, and the alkylation unit at 2,300 bbl. daily.

An 80,000-bbl. distillation unit is under construction. It will be the refinery's fourth. When it opens next year, it will put Cardon in the 250,000-bbl. class.

The refinery's rated capacity before the new units opened was 145,000 bbl. daily. But actual intake was 189,000 bbl. daily, including feed for a thermal cracker.



The Manuay 1 is slated to go to 12,000 to 15,000 ft.

Deep Drilling Push

. . . may make or break Cuba. Several companies are pouring millions into deep wells both on and offshore

IN THE FOREFRONT of Cuba's current deep-drilling play is the Manuay 1 (see photo), a test being drilled by a little-known company that has some well-known backers.

Cia. Petrolera La Estrella de Cuba is drilling the well a mile off the northern coast of Camaguay and about 10 miles east of the border of Las Villas province. The well is drilling below 1,800 ft. and is scheduled to go to 12,000 to 15,000 ft. C. G. Glasscock Drilling Co. is contractor.

While "La Estrella" is little known outside Cuba, companies behind the offshore venture include the biggest in the business. Royal Dutch-Shell owns 60 per cent. Canadian Eagle Oil Co., Ltd., a British company working closely with Shell in many ventures, owns 40 per cent.

Standard Oil Co. (N. J.) sold its interests in La Estrella last year, but is putting up some cash for exploration on the 650,000-acre coastal and offshore area. Atlantic Refining Co. also is sharing expenses and any profits.

The Manuay 1 is one of several tests planned in the most concentrated deep play in Cuban history. Five wildcats were drilled earlier from 5 to 15 miles from the Manuay 1. The deepest was on Cayo Coco Peninsula, bottomed at 10,563 ft.

Here are some of the current projects:

. . . **A Gulf Oil Corp.** subsidiary plans deep tests on 1,500,000 acres. Reportedly four 10,000 to 11,000-ft. tests are planned in a farmout agreement with The Texas Co. Most of the acreage is in Las Villas.

. . . **Gulf and Cuban Kewanee** Oil Co. are drilling ahead at 9,080 ft. in Collazo 1. The wildcat is located a few miles south of Manuay 1. La Estrella is putting up dry hole money in exchange for information on the test.

Gulf also holds 62½ per cent interest in a 24,700-acre block in Las Villas on which the Escambray 1 was given up at 5,200 ft. after a fishing job. Consolidated Cuban Petroleum Corp. has 25 per cent interest, and C. J. Simpson, 12½ per cent.

. . . **Atlantic Refining Co.** has started its first well in a six-to-nine-well program in Pinar del Rio. The Remedios 1 is drilling ahead at 2,796 ft. Jones Bros. Drilling Co. is contractor.

. . . **Cuban Stanolind** Oil Co. has staked a location for Tortuga Shoals 1, a deep test to be drilled off southern Las Villas. Stanolind also has a coring program under way in Oriente.

. . . **Siboney - Carribean** Petroleum Co. may go to 10,000 ft. in its Cacique G-1A. The company had temporarily abandoned the well at 6,695 ft. The test is on the south coast of Camaguay.

Crew Is Attacked

by Nationalists in Algeria. Legion guards are slain.

THE MEANING of political instability in Algeria has been brought home to oil hunters in an attack on a geophysical survey crew by Nationalist guerillas.

The raid hit a convoy working for Cie. des Petroles D'Algerie 40 miles north of Timimoun. The company is 65 per cent owned by Royal Dutch-Shell.

First reports were that nine Foreign Legionnaire guards were killed, and five civilians were casualties. The rebels hit twice. A desert force has arrived to protect company employes, most of whom apparently were not hurt. It was not learned immediately whether an American team was involved.

Timimoun lies well within the licensing area of Algeria. The nearest acreage currently open to bids by American companies lies about 200 miles to the northeast.

The attack followed by 2 weeks a meeting of top Nationalist leaders in Tunis. They made clear their desire to put further pressure on France by making the Sahara insecure.

How the A.P.I. is helping to answer:

1. What are the source materials of petroleum?

2. How are they converted to gas and oil?

3. What is necessary for their operation?

4. How important a factor is time?

EXPLORATION

By C. I. Alexander

GEOLOGY, in the broadest sense, is the study of the history of the earth and its inhabitants. However, if this history is to be really complete, the first chapter should begin at the beginning and relate the story of the origin of the elements. This chapter is being written today by the nuclear physicists. The second chapter belongs to the students of astronomy and cosmogony. They must be called upon to relate the manner in which our earth came into being as a member of the solar system, and our solar system as an entity in the universe. Finally, geology merges with the studies of anthropology, ethnology, and history.

Geology may be regarded as taking responsibility for elucidation of the earth's history at the time when the earth acquired a permanent solid crust. From that time on, geology is concerned with the succession of events which are responsible for the physical features of the earth we see around us today, the composition of the rocks of the observable crust, and evolution of the animals and plants which have inhabited our planet from their unknown beginning to the present time.

Geologists realized long ago that they could not hope to explain the presence and development of major features of the earth's surface, such as the continents and ocean basins, the plateaus, plains, and mountains, without a knowledge of the composition and physical state of the interior of the earth. Forunately, during the past few years an increasing number of highly competent chemists and physicists have become interested in these and other problems of geology.

The titles of two recent books, "Nuclear Geology" and "Isotope Geology," have a strange sound indeed to those who studied geology 30 years ago. But those who probe the atom, and those who probe the core of the earth with natural and man-made seismic waves, will eventually provide the knowledge we need to understand the processes by which our earth became what it is today.

Geological studies of origin of petroleum . . . The American Petroleum Institute has reason to be proud of the contributions it has made to an understanding of the events and processes of earth history. It is interesting to observe that four of the first five fundamental - research projects sponsored by the A.P.I. were geological studies. Project 1, "Generation of Oil in Rock by Shearing Pressures," was conducted by Prof. Warren J. Mead, of University of Wisconsin. Project 1 came into being on September 1, 1926, and continued to June 30, 1931. Project 3 was entitled "Studies of Conditions Under Which the Solid Material in Source Rocks Changes into Gases and Oils."

The investigator was Dr. David White, of the United States Geological Survey; the dates, July 1, 1926, to June 30, 1931. Project 4 was entitled "Origin and Environment of Source Sediments." The investigators were Parker Trask, Harold Hammer, and C. C. Wu. Project 5, "Diatoms as a Source of Oil," was a study conducted by Prof. L. B. Becking and Prof. C. F. Tolman, of Stanford University.

You will note that all four of these early A.P.I. projects were trying to answer questions which had puzzled and intrigued geologists for half a century. These same questions are still with us today: What are source materials of petroleum? What are the steps in its conversion to gas and oil? What conditions are necessary for their operation? How important a factor is time? Project 43, "Transformation of Organic Materials into Petroleum," subdivided into Projects 43a, 43b, and 43c, began officially in 1943 and terminated in 1952; it was a three-pronged assault upon the same questions.

Actually, the problem is so broad that none of these projects supplied complete answers. However, they all contributed bits of fundamental information upon which later workers have been able to build. This same problem of the origin and evolution of petroleum hydrocarbons is under more massive attack today, in both academic and industrial research laboratories, than at any time in the past.

And today, because of recent advances in analytical techniques and tools such as chromatography, infrared spectroscopy, mass spectrometry, and others, we have a much better chance of success than ever before. I believe, without question, that these early A.P.I. projects not only contributed important bits of knowledge, but stimulated much of the interest in this field of investigation which is in evidence today.

You may feel that the topic which I have been discussing is more prop-

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erly regarded as a phase of geochemistry rather than of geology. If you do, well and good. This is simply an example of the application of other scientific disciplines to the study of the processes involved in important events in the earth's history. However, I believe you will all agree that any chemist who attacks the problem of the origin of oil in the laboratory, without due consideration of the conditions and limitations imposed by the known facts of geology, has a good chance of coming up with some answers incompatible with these facts. Further, I feel reasonably certain that if the studies conducted under Projects 1, 3, 4, and 5 were submitted to A.P.I. today, they would be referred to the Geological Domain Committee for consideration.

Geological projects . . . In addition to these studies dealing with what we may call organic geochemistry, five strictly geological projects and at least two others contributing fundamental knowledge of earth properties or materials have been sponsored by the A.P.I. Three of these projects are still active today.

Project 22 was entitled "Thicknesses and Characters of the Strata in the Deeper Sedimentary Basins of North America." Dr. Raymond C. Moore, of University of Kansas, was the investigator. Project 23, conducted by Dean A. H. Daniels, of University of Illinois, was entitled "Limestones and Dolomites as Reservoir Rocks." Project 24, entitled "Structural Relations of Beds That Are Separated by Converging Strata," was conducted at University of Ok'ahoma under the direction of Dr. V. E. Monnett. Project 51, "Study of Near-Shore Sediments and Their Environments in the Northern Gulf of Mexico," is perhaps the most familiar of the geological projects sponsored by the Institute; first, because it is the largest, and, second, because it is still on the active list.

Project 53, "Geochemistry of Uranium-Lead Systems (Age Dating)," formerly entitled "Age Dating of Sedimentary Rocks," is also still active. The object, of course, is the improvement and extension of absolute age measurements of rocks. The work, started officially July 1, 1955, under the direction of Dr. Harrison Brown, is being directed by Dr. C. C. Patterson, of California Institute of Technology, as of July 1957. Two projects which, while not strictly geological, are nonetheless of importance in the understanding of earth history are: Project 25, "The Determination of Geothermal Gradients in Oil Fields on Anticlinal Structures," now completed; and Project 55, "Hydrothermal and Structural Studies of Minerals," now under way under the direction of Dr. Rustrum Roy and Dr. G. W. Brindley, of Pennsylvania State University.

Geophysical projects . . . A.P.I. support of purely geophysical studies is only 2 or 3 years old. Inasmuch as geophysical methods are simply ways and means of measuring the distribution of materials of varying physical properties, at depths down to and including the very central core of the earth, any information developed by any fundamental research in geophysics is of major importance to geology. Some of these investigations supply new data. Others, such as the current study of the scattering of seismic waves, will illuminate major problems and help to evaluate old, current, and future data. This scattering study, incidentally, is the first study of project status sponsored in the field of geophysics by the A.P.I., and is being conducted as Project 59, "Theoretical and Model Studies of the Scattering of Seismic Waves in the Earth," under the direction of Prof. L. B. Slichter, of University of California.

Project 51

Let us return now to Project 51. This project, as already mentioned, is a study of near-shore sediments in the northern Gulf of Mexico. What are we trying to find out about these sediments, and why are we interested in such a study in the first place?

Generally speaking geological and geophysical exploration for petroleum and natural gas has consisted largely of the search for structures — anticlines, salt domes, and faults—which might form favorable traps for these hydrocarbons. The tools used have been surface geological mapping; geophysical mapping, including gravimetric, and seismic methods; and subsurface geological mapping, based on correlations established by lithologic logs, paleontology, and electrical and other physical logging methods. In all cases, emphasis has been on structural mapping. Today we are faced with increasing difficulty in finding new reserves, particularly in the United States. Most of the big structures have undoubtedly been found. The structural traps we are finding today are, on the average, smaller and, consequently, contain less oil than those we were finding a few years ago. In the near future, we may expect to be faced with similar conditions in other parts of the world.

Stratigraphic traps . . . The future of petroleum exploration may not be quite as dark as it seems, however. Most exploration men are convinced that large reserves of oil and gas remain hidden in stratigraphic traps. These traps are extremely difficult to find by any of the conventional geological or geophysical methods. New tools and new techniques are needed.

For example, the existence of a barrier beach or offshore sand bar, deposited in some ancient sea and now buried beneath thousands of feet of subsequent sedimentary deposits, would be extremely difficult to predict in advance by any conventional geological or geophysical methods. Such a sand body could form a stratigraphic trap for oil and gas. A buried sand bar 4 miles long, ½ mile wide, and 20 ft. thick could contain roughly 50,000,000 bbl. of oil. How do we propose to go about finding such buried sand lenses?

Obviously, a barrier beach or sand bar and the adjacent sedimentary environments can best be studied where they are being formed today. We can dissect them bit by bit; we can observe materials of which they are composed and the changes which occur at their boundaries. It is on the basis of such fundamental data that, from a single core outside the hidden sand lens, we may hope to find evidence of its presence and location.

We need to know how barrier beaches and sand bars vary one from another and, even more important, what they have in common which will distinguish them from other similarly shaped deposits. For instance, how do they differ from river bars?

Essentially, what we need in the search for stratigraphic traps are methods of mapping, the details of paleogeography. This science, in the past, has consisted largely of generalized mapping of the extent of the ancient seas which have invaded the continents over and over again throughout geologic time, and of drawing a generalized picture of the structural and physiographic character of the land areas which surrounded these ancient seas. Now we cannot be content with the generalized picture. We must map every rise and fall of sea level along the ancient shore lines. We must learn where to look for the beaches, the offshore sand

bars, and the deltas of the ancient seas.

Modern sediments . . . Today we do not have the basic data necessary to do this job. The modern sediments contain the clues we need. The study of modern sediments is the key to our major future reserves.

In 1946 and 1947 the research committee of the American Association of Petroleum Geologists, under the chairmanship of Dr. Shepard W. Lowman, surveyed the field of geology to determine the geological tools most urgently needing basic research. Hundreds of the most prominent petroleum geologists in the world were canvassed for their opinions; the study of modern sediments received the highest priority rating. As might be expected, the directors of the A.P.I. were already looking ahead and anticipating the need for new basic geological data if reserves were to be maintained at an adequate level. In consequence, the Institute sponsored the A.A.P.G. Research Committee project and furnished a grant to University of California to start A.P.I. Research Project 51. Work was started on Project 51 at the Scripps Institution of Oceanography, La Jolla, Calif., July 1, 1951, under the direction of Dr. F. P. Shepard.

Project 51 is a part of the program of University of California's Institute of Marine Resources, of which Adm. C. D. Wheelock is acting director. Dr. Roger Revelle, director of Scripps Institution of Oceanography, is also chairman of the institution's Project 51 committee. Dr. F. P. Shepard has recently been joined by Dr. Tj. H. van Andel, formerly with University of Groningen, Holland, as codirector of the project.

(1) Physical Properties:

A complete study of recent marine sediments is a pretty comprehensive job. Perhaps the first and most obvious step is to take a look at the physical properties of the sediments. Can we detect any differences in grain size, or in degrees of sorting, which will serve to distinguish the sands of a beach, a barrier island, or an offshore sand bar? What effects do winds, waves, and currents have on the orientation of any elongated grains in each of these environments?

We know that the sands of beaches usually grade into finer-grained sediments seaward; those of barrier islands and offshore bars may grade into finer sediments both shoreward and seaward. How abrupt, or how gradual, is this transition? Is is uniform in rate for any one type of sand body, or is it variable? Are there any gradients in grain size in the adjacent fine-grained sediments which will indicate the proximity and direction of the sand body?

You cannot answer questions like these by examining only a few samples! And you cannot be satisfied with even lots of samples from one beach. You need many samples from several examples of each of the environments which you intend to study. And, before you are through, you must examine the sediments of each of your environments in three dimensions. The criteria observed on the surface must be present and recognizable with depth, or they will be of no significance in our studies of paleogeography.

(2) Animal Life:

Next we might consider the animal life, both great and small, which creeps, crawls, swims, or floats in the water covering or adjacent to our sediments. We shall be concerned mostly, although not entirely, with animals that have a hard shell of some kind, which gives them a good chance of being preserved as fossils after burial in the sediments. Such animals are the oysters, clams, snails, echinoids, and the microscopic Foraminifera, and Ostracoda.

Some marine animals are known to prefer a sandy bottom upon which to crawl, or over which to swim; others prefer a muddy bottom. Some are found only in shallow water; others prefer greater depths. Some live only in fresh or brackish waters; others in the more saline water of the open sea. We must first learn which particular animals live in the various environments in which we are interested.

Then we have another question to answer. After the death of the animal, what happens to his shell? Does it remain in the environment in which it lived, or do waves and currents tumble it about and transport it, either whole or in fragments, to an environment completely foreign to its former owner? If the shells or shell fragments are transported, how far? Can we hope to find increasing numbers of shells or of recognizable fragments as we approach the environment in which the animal lived?

These are important questions, and they must be answered if we are to know how to use fossils in our study of paleogeography. And again, it will require lots of samples to tell the story.

We have discussed only two aspects of the study of sediments—the physical properties and the relation of the animal life to the various sedimentary environments. There are, of course, numerous other possible approaches, involving a variety of scientific disciplines. Some of these will become apparent as we continue our discussion with a review of some of the significant new information which has been revealed by the efforts of the scientists working on Project 51.

(3) Results:

One very important fact—perhaps the most important—developed by this study is that recognition of the environment of deposition of a sediment usually requires a variety of techniques. Although the over-all characteristics of the sediments in the various environments may be quite distinctive, there are confusing similarities in widely different environments if only one or a few criteria are used.

Studies of sand-grain orientation have shown that in beach deposits, elongated grains tend to be oriented with the long axis at right angles to the shore. This is undoubtedly attributable to the action of tides and waves, and is in direct contrast to the orientation found in river deposits. In the latter, the grains are oriented parallel to the long axis of the sand body. Thus, in subsurface studies, the orientation of grains could be used as an important clue to the environment of deposition of a sand body of unknown origin, or, conversely, if the mode of origin of the deposit were known from other evidence, could be used to predict the "trend" of the sand body.

Barrier islands, separated from the mainland by the shallow bays or lagoons, are common features of the northern Gulf Coast. Barrier islands undoubtedly existed along many ancient shore lines, and such extensive sand bodies as these would make extremely attractive stratigraphic traps for oil and gas. Study of the muddy sediments of the bays on one side of barrier islands and of apparently similar muddy sediments on the other, seaward side has resulted in the discovery of significant differences between the two. The muddy sediments of the open gulf, for example, are characterized by appreciable amounts of glauconite and echinoid fragments. Neither type is found in bay sediments. In both offshore and bay muds, the approaches to the barrier islands are indicated by rapid increases in the sand content.

In sediments deposited out in the

open gulf, on the Continental Shelf, there is a definite relationship between the distance from the shore line and the ratio of benthonic (bottom-dwelling) to planktonic (waterborne or floating) Foraminifera. Inner-shelf deposits, out to about the 20-fathom line, lack the abundant planktonic Foraminifera which charterize the outer shelf. Nearness to entering rivers can often be determined by increasing quantities of plant fibers in the sediment, and by increasing ratios of Ostracoda to Foraminifera.

Comparison of the Foraminiferal population found living in a given environment with the dead shells collected in the same environment, as a means of evaluating the importance of transportation of dead shells in the mixing of the faunas, represents a new approach to a study of the biological evidences of environment. In general, transportation of dead shells from the normal habitat of the animal to a foreign environment has been found to be a less serious problem than paleontologists had feared it might be.

Further, living Foraminifera are being cultured in aquaria, in the laboratory. In this way it is possible to determine the ranges of salinity, temperature, and other environmental conditions under which various species can live, grow, and reproduce. By varying only one factor at a time, while keeping all others constant, these studies will reveal more than we have ever known before about the environmental significance of these little animals.

Project 51 is expanding a basic phase of study which may have a far-reaching effect on the thinking of the petroleum industry. It is another and new approach to a question which we have already mentioned as being the subject of several earlier A.P.I. projects. It is not, as some of them were, an attempt to obtain a direct answer to the question of the origin of oil, although it may have an important bearing on the potential richness of sediments deposited in different environments. As you know, only plants and certain primitive animals can manufacture new organic material from sunlight and inorganic substances. Project 51 has found great variation in the amount of new organic material being formed in the different environments. This study includes not only the rate of formation of organic matter in different environments, but also its percentage of preservation through burial in the sediments.

In addition to new facts, Project 51 has contributed new techniques for the study of sediments. Although these were developed primarily for the study of unconsolidated recent sediments, some of them can certainly be applied, in combination with proper disaggregation of the rock, to ancient sediments as well.

I have mentioned only a few of the many important direct contributions made by Project 51 to the basic knowledge of sediments and sedimentary processes. It requires but a minimum of imagination to see how this knowledge can be used to good advantage in our explorations for the oil and gas which we all feel certain lie hidden in stratigraphic traps.

In addition to these direct contributions of facts and techniques, Project 51 has also resulted in the training of numerous graduate students. Some of these are now teaching at other institutions; others are in the employ of various oil companies. Further, the published results of the project have acted as a powerful catalyst to stimulate the thinking of the entire geological profession. Oil-company geologists are already attempting to utilize the data of Project 51 in the search for additional reserves. Much of the research in the field of recent sedimentation which is going on today in academic institutions all over the world owes its stimulus to the oral and written dissemination of the results of Project 51.

Symposia . . . The Geological Domain Committee recently conducted an interesting experiment. To give credit where it is due, I am afraid we shall have to admit that we borrowed the idea for the experiment from the Geophysical Domain Committee. The fact that the Geophysical Domain Committe has used it with success inspired us to try. At any rate, we invited, at A.P.I. expense, 11 outstanding research workers, representing the geological departments of 11 colleges and universities from coast to coast, to a symposium on the subject of carbonate sediments. Here was a group of real experts, all with a common interest in the study of carbonate rocks, but each with a somewhat different approach. Each man was given an opportunity to describe his own work and that of his colleagues at the institution he represented.

The discussions and questions which followed each presentation indicated a high level of interest on the part of all participants.

Other symposia, covering other phases of geological research, are planned for the future. As a result of these symposia, we shall undoubtedly develop a better basis for establishing what research we shall want to recommend for A.P.I. sponsorship, either as projects or as grants in aid. But I am not at all sure that this is the main benefit to be derived from these symposia. The opportunity provided for the exchange of experiences and ideas among groups of the country's leaders in the various fields of geological research is in itself a contribution of immeasurable value.

We shall never know all we should like to know about the history of our planet. But we are learning. And our rate of learning is definitely accelerating. The A.P.I. is playing an important part in the acceleration. **End.**

How the industry is applying knowledge gained from

A.P.I. Research Projects

By H. W. Field and C. E. Headington

A.P.I. fundamental research has produced a tremendous amount of technical information about petroleum that is rapidly being translated into industry progress by its recipients.

It has made possible the development of important new petroleum-processing methods; it has provided the material for hundreds of technical publications; it has played a very significant part in helping colleges and universities train scientists for industry, and it has stimulated academic research in the field of petroleum.

With the program organized in its present form, progress in the next 10 years should be even more spectacular than it has been in the past 10.

In view of the large sums of money that the petroleum industry is spending today on A.P.I. fundamental research, it seems to be a good idea to frequently cast up an appraisal of the value of this research to its contributors. In order to get a better look at what this acquisition of knowledge has done for us, let us first take a quick look at what we have found on each of our A.P.I. projects and then see what we are doing with it.

Providing more pure hydrocarbons

Project 6 . . . Let us look first at our earliest venture, Research Project 6, "Analysis, Purification, and Properties of Petroleum Hydrocarbons." The work here has isolated to date 151 different hydrocarbons from a representative Mid-Continent petroleum. Many new separation techniques have been developed which are now available for use in any petroleum laboratory.

One of the newest tools developed on this project is the use of the newly available fluorochemicals alternately with polar organic compounds such as methyl carbitol in azeotropic distillation and liquid-partition chromatography. This powerful technique is giving separations between hydrocarbons previously not considered separable.

It is resulting in the discovery of hydrocarbons in petroleum whose presence was hitherto unsuspected. Such unusual and exotic molecules as methyl-bicyclo (2, 2, 1) heptane and bicyclo (3, 2, 1) octane are recent examples.

During the early days of World War II the highly purified hydrocarbons isolated from petroleum by Project 6 became very valuable as standards for calibrating infrared, Raman, ultraviolet, and mass spectrometers for hydrocarbon analysis. These analyses in turn provided the control methods that were so badly needed in operating the high-octane gasoline plants which eventually were to help win the war for us.

The supply of these pure hydrocarbons, however, was completely inadequate, and it was decided therefore that Project 6 would take on the responsibility of making available to private industry as many different pure hydrocarbons as possible.

These could be synthesized, contributed as mixtures by private industry, acquired from other A.P.I. projects, or acquired from any other source; but Project 6 would acquire them, purify them, establish their purity and sell them as pure standards, the proceeds always to go toward the preparation of more pure standards.

As of June 30, 1957, 253 different hydrocarbon compounds have been purified and made available as A.P.I. standard samples, and that the research results of this plus all the other work of Project 6, has provided the material for 155 publications including 1 excellent reference book of more than 500 pages. The demand for these standard samples has been so great that we are faced continually with the problem of replenishing them.

Authors are with Atlantic Refining Co.
Paper presented at annual A.P.I. meeting, Chicago, under the original title, "A.P.I. Petroleum Composition Research — a Soul Searching."

Finding the knocking octanes

The work . . . Under Research Project 45, "Synthesis, Purification, and Properties of Hydrocarbons of Low Molecular Weight," is also closely allied to that of Project 6. Because gasoline components vary widely in knocking characteristics, industry needed to know which were good and which failed to measure up in this respect.

Project 45's first objective was to make pure hydrocarbons and test them for knock. The project workers made the hydrocarbons and industry tested them cooperatively in industry engines. This work is now largely completed, and the project has a list of 368 pure compounds which it has fingerprinted for knocking tendency under as many as 18 engine conditions.

Project 45 had acquired a vast storehouse of knowledge on hydrocarbon synthesis, and, consequently, Project 45 scientists came to the aid of Project 6 and prepared the lion's share of the hydrocarbons which Project 6 subsequently purified and sold as standard samples.

Over a period of 19 years the production of these hydrocarbons has developed a new chemical knowledge of hydrocarbon synthesis. This knowledge gleaned from Project 45 has provided the material for 54 scientific publications. A further contribution to industry is represented by the 64 men who were trained on the project, all of whom are now in industry.

Thermodynamic properties

Two other projects closely allied to both Projects 6 and 45 are Research Project 44, "Data on Hydrocarbons and Related Compounds," and Research Project 50, "Thermodynamic Properties of Hydrocarbons and Related Compounds."

The purpose of Project 44 is to compile and classify authoritative physical, thermodynamic, and spectral properties of hydrocarbons and related compounds. The compilation of data from this project now contains more than 5,600 individual sheets of loose-leaf data which are distributed free to all contributors to the A.P.I. research fund.

The data are purchased by other companies at a price which returns the cost of printing and shipping. These data are supplied gratis to universities, libraries, and other nonprofit institutions throughout the free world. There are, all, told, 626 gratis recipients of these data, 393 scattered through all 48 states of the United States and 233 in 28 foreign nations.

Project 50 is concerned with methods for calculating the thermodynamic properties of hydrocarbons and related compounds. It was initiated for the purpose of obtaining a better understanding of the energy relationships which determine how a hydrocarbon, or group of hydrocarbons, will behave in a process such as isomerization.

It has only been in existence since 1952, but some idea of the results of this work can be gained from the fact that during the period of only 5 years this work has yielded the material for 32 technical publications and has provided industry with 15 new Ph.D.'s in chemistry.

The big molecules studied

Research Project 42 . . . This project, "Synthesis and Properties of High-Molecular-Weight Hydrocarbons," represents our attempt to learn the nature and properties of the big molecules in petroleum. This project is making spectacular progress in synthesizing the "can't be made" and "unheard of" compounds suspected of being present in these fractions.

Project 42 scientists are also charting their way through this maze of possible hydrocarbons in such a way that, by correlating their fundamental properties and using the calculation methods developed under Project 6, a minimum number will have to be synthesized in order to predict what the other hydrocarbons will be like.

These large molecules do not come easily and all of them require the best in the way of ingenuity and creativity on the part of Project 42 chemists in synthesizing them. Despite this, however, the project has, during its short span of 17 years, synthesized and purified approximately 260 pure high-molecular-weight compounds.

It has determined and computed more than 7,000 pertinent fundamental physical properties and established important correlations of these properties with molecular structure. It has loaned out for scientific studies more than 1,000 samples of these hydrocarbons.

It has trained 26 Ph.D.'s and 20 masters-degree candidates, and it is considered by the university where it operates to be a most important part of its educational program. More about the uses of these data later.

Sulfur and its effects

Project 48 deals with "Synthesis, Properties, and Identification of Sulfur Compounds in Petroleum." Research Project 52 is devoted to "Nitrogen Constituents in Petroleum." In Project 48 approximately 50 sulfur compounds have been isolated and identified in Wasson crude oil.

Of the theoretically possible 21 sulfur compounds boiling below 212° F., 16 have been isolated and identified. The remaining five are low-molecular-weight unstable cyclic sulfides and are therefore probably not present in crude oil. Thirty-five highly purified compounds have been prepared in large enough amounts to be sold by the A.P.I. as standard samples, and more than 500 spectra have been obtained and distributed.

Project 52 is our youngest project although it was preceded many years ago by A.P.I. Research Project 20, "Isolation and Investigation of Nitrogen Compounds in Petroleum," which is no longer in existence. Project 20 succeeded in isolating from a kerosine distillate some 10 pyridine and 23 quinoline homologues. This work established fairly well that the basic nitrogen compounds in petroleum are mainly pyridine and quinoline compounds.

Project 52 is therefore concerning itself chiefly with the nonbasic nitrogen compounds. The work was not started until 1954, and, for this reason, there is not much to report yet on specific findings. The project is well organized, however, and methods of synthesis of nitrogen compounds are developing as well as techniques for isolating these compounds from crude oil.

Approximately 11 compounds have been synthesized to date and will soon be ready for distribution as standard samples. We have every reason to believe that eventually this project will paint us a picture on nitrogen very similar to the pictures now evolving from Projects 6 and 48 on hydrocarbons and sulfur.

and now . . . the application

One of the first and biggest steps in the application of all this new knowledge of petroleum composition has been the development of a whole new approach to the analytical chemistry of petroleum. During the war the analytical chemists joined forces with the physicists, and the result was some fearful and wonderful new weapons which masqueraded under some very impressive names.

Unfortunately, the petroleum analytical chemists were still unable to use their new weapons because they had no ammunition for them. This ammunition in the form of mass, ultraviolet, Raman, and infrared spectra of the pure compounds in petroleum is now being supplied by the A.P.I. Fundamental Research Program (particularly Projects 6, 42, and 44), and for the first time in history the analytical chemist is able to tell the process chemist and engineer a great deal about what they are working with and what they are making.

Small wonder then that in the 1920's we had no alkylation, no isomerization, no polymerization, no catalytic cracking, no catalytic reforming, no synthetic rubber, and no petrochemicals. These are all processes which depended for their development on at least some knowledge of the compo-

sition of the starting material and of the final product.

Had we not obtained that information it would have been a long, hard, and probably impassable road to the present stage of development in the petroleum industry. For instance, in catalytic reforming, we have developed catalysts to do specific chemical jobs. Cyclopentanes are isomerized to cyclohexanes; cyclohexanes are dehydrogenated to aromatics; and paraffins undergo both isomerization and hydrocracking to give higher octane paraffins.

By varying the properties of the catalyst and the operating conditions, we can control each of these reactions, and it is possible by these means to raise the octane number of a straightrun naphtha from 20 up to 100 or more. The developers of the catalytic-reforming processes have been frank to admit that they have been completely dependent on composition knowledge for the development of this process, and A.P.I. research has been largely responsible for the methods by which we are able to obtain this composition picture.

Catalytic reforming is only one typical example of the application of composition information. It is undoubtedly true that there is hardly any phase of light-hydrocarbon processing today that has not been drastically affected for the better by new knowledge of gasoline composition which, in the main, can be traced back to the door of A.P.I. Project 6.

We, at Atlantic, believe that the use we have made of the A.P.I. pure hydrocarbon standards alone has been worth more to us than our whole contribution to the A.P.I. Fundamental Research Program.

Thermodynamics data . . . What about the mass of thermodynamic and other data amassed under Projects 44 and 50? There is no doubt that the availability of an authoritative compilation of data, such as these projects have provided, has been a tremendous stimulant to all research and engineering in the field of petroleum throughout the free world.

In a recent check in one petroleum laboratory alone, it was found that 19 sets of the physical and thermodynamic data were in constant use by process-design engineers and research scientists. The research people in another laboratory state that no process research is started in their laboratory until all possible thermodynamic calculations have been made using the A.P.I. data. Their only criticism is that there still is not enough of these data.

That the catalogs of spectral data are invaluable is unquestioned in technical circles. They are stimulating new research, opening up new horizons in research, and saving thousands of man-hours in all of our major laboratories.

It is interesting to note that the Manufacturing Chemists' Association, Inc., has taken a leaf from our book and is now establishing a means for accumulating similar information on the nonhydrocarbons for the benefit of the chemical industry.

One of the most significant contributions of Project 44 has been the development of methods for calculating the physical properties of compounds even though these compounds may never have been available before for physical-property measurements. As a matter of fact, these calculations often yield more accurate values than it is possible to measure experimentally.

These calculation methods will be even more useful in the future as attention is shifted to higher molecular weight hydrocarbons. Here the tremendous number of isomers makes individual compound isolation and study impossible. Methods are being perfected to permit obtaining accurate data on a few isomers which can then be used to cover all other isomers.

Lubricants and waxes . . . Much work on Project 42 pertains, of course, to problems bearing on the quality and processing of lubricating oils and waxes. These data have been used exclusively in research on such things as friction and wear, surface properties and the dependence of viscosity, viscosity index, and stability on molecular structure.

It has taught the industry what molecular configurations in lubricating oil give the highest viscosity indexes, the lowest pour points, and what their solubilities are as they pertain to solvent-extraction processes.

For instance, we used to say, with some confidence, that if, on a molecular scale, our lubricating oil looked like a plate of spaghetti it had a high viscosity index, while if it looked like a plate of peas, it had a low viscosity index. Project 42 revised our ideas about this, however, because, approximately 2 years ago, they synthesized a roly-poly, pealike molecule, perhydrofluoranthene, which had a viscosity index of 137.

The mass spectrometer is undoubtedly one of the most powerful and useful analytical tools ever developed for use on hydrocarbons. Its extensive use today on the fractions higher boiling than gasoline is almost completely dependent on the Project 42 loan bank of high-molecular-weight hydrocarbons.

Calibration of mass spectrometers with these hydrocarbons enables the analytical chemist to make detailed analyses of waxes and lubricating oils and burning oils in terms of molecular weight and hydrocarbon type. These analyses are extremely helpful to the process chemists and engineers is devising new processes for improving the yield and quality of these products.

In short, it is probably safe to say that practically every industrial-research program today, dealing with fuel oils, waxes, industrial oils, and motor oils, has benefited to some degree by the results obtained on this project. Furthermore, its usefulness is amply evident from the intense interest shown in it by all industrial-research laboratories.

Nonhydrocarbon research . . . Project 52 is hardly far enough along yet to be able to point to any positive applications. There is every reason to believe, however, that it will be useful. It is believed that the secret of the origin of petroleum is linked closely to its nitrogen content, inasmuch as it still contains some of the metallo-organic nitrogen compounds similar to hemoglobin and chlorophyll which are found in living plants and animals.

The processing of shale oil, bitumens, and other nonpetroleum sources of fuels should also be greatly expedited by this knowledge, because many of them contain relatively large quantities of nitrogen compounds.

Concerning Project 48, on sulfur compounds, one can safely say that prior to start of this project, essentially no reliable information was available on the fundamental properties and the nature of the sulfur compounds in petroleum.

Although no strikingly new processes have been revealed which can be directly attributed to Project 48, we know that many companies have found the project data very helpful and very useful in suppressing their sulfur problem. The development of analytical methods through the use of pure compounds has undoubtedly been fruitful, and two relatively recent observations on the project may prove to be very significant.

The first is the indication that the sulfur in the higher boiling fractions is present predominantly in the form of thiophenes and cyclic sulfides. The second is the fact that recent work suggests that the heavy fractions of at least some crude oils consist principally of sulfur compounds contaminated with a few hydrocarbons.

Theoretical and experimental observations on

Static Electricity in petroleum products

By D. T. Rogers, J. P. McDermott, and J. C. Munday

THE PRODUCTION of static electricity in liquid hydrocarbon fuels is associated with the presence of colloidal contaminants which ionize in the hydrocarbon environment. The contaminants are largely organic in nature and represent fuel degradation and oxidation products or residues from treating operations. They are only partially removed by ultrafiltration, but can be almost completely removed by adsorption on silica gel or activated clay.

The electrical potency of fuels is markedly increased by exposure to elevated temperatures, ultraviolet or gamma radiation, or by the addition of contaminants such as asphalt.

The rate of charge production increases with flow rate and is accelerated by small amounts of water, air, and dispersed solids. The effect of temperature is variable. Raising the temperature in the range of 50° to 105° F. reduces static production with some fuels, but increases it with others. The nature and condition of the charge-separating surface are of importance also.

The discharge of static electricity as visible sparks from the surface of hydrocarbons takes place most readily at points of high curvature, and the potential at which it takes place decreases with increasing conductivity. With some commercial fuels, discharges take place within the liquid phase at potentials not greatly different from those for air. Under some laboratory conditions static production is so intensive that discharges occur in the liquid, and in the presence of air these could lead to submerged explosions.

Authors with Esso Research & Engineering Co. Paper presented at A.P.I. annual meeting, Chicago,

The production of electrostatic charges by hydrocarbon mists and fogs is under study.

Antistatic additives have been found which, in low concentrations (0.005 per cent), generally reduce static production to low levels in laboratory tests. Under some conditions much higher concentrations may be required. The use of additives may be limited to systems where the electricity is produced in, and discharged from, the liquid hydrocarbon.

Published reports[1] on the triboelectric properties of fluids suggest that electrostatic charges can be built up whenever there is motion of a hydrocarbon relative to a second substance, which may be present as a solid, liquid, or gas. These conditions are summarized in Table 1. In this outline, methods of charge production are classified according to whether the hydrocarbon is moving or stationary. It will be noted that the methods listed as items No. 1 and No. 2, under each category, are really identical mechanisms. In both, the liquid hydrocarbon represents the continuous phase. They differ only in that in one case the hydrocarbon is moving and in the other it is not.

Most investigators agree that in order to obtain high rates of charge production in mechanisms No. 1 and No. 2, where the hydrocarbon is the continuous phase, there must be contaminants in the hydrocarbon, or in the equipment, which can result in charge separation; i.e., materials must be present which are capable of producing ions in the hydrocarbon environment. Entirely pure hydrocarbons, in a system where no other contaminants are present, would not be expected to produce high levels of static electricity under these conditions.

If, on the other hand, the concentration of impurities is sufficiently high, so that the specific conductivity of the hydrocarbon is in the order of 1×10^{-11} ohm^{-1} cm.$^{-1}$ or higher, the rate of dissipation or decay of the charge will be so rapid that substantial electrostatic fields should not accumulate. The data showing the relationship between conductivity and calculated decay rates are shown in Table 2.

TABLE 2—CONDUCTIVITY AND DECAY RATES

Specific conductivity (ohm^{-1} cm.$^{-1}$)	Time for 50 per cent decay (seconds)
10^{-11}	0.013
10^{-12}	0.13
10^{-13}	1.3
10^{-14}	13.0
10^{-15}	130.0

In the mechanisms of No. 3 (see Table 1), however, static production may be obtained regardless of the purity or the conductivity of the hydrocarbon; i.e., in some instances static can be produced with hydrocarbons that would not produce static in the liquid phase. In these mechanisms the hydrocarbon vapor-air mixture is the continuous phase.

Although considerable information has been published on the electrokinetic properties of fluids, very little work has been reported on the mechanisms by which the electrostatic discharge takes place. Theoretically, the discharge may follow a number of paths. In those systems where the charge accumulates in the liquid hydrocarbon, the discharge of this electricity may take place slowly to the walls of the receiving vessel, or it may take place as a visible discharge across the surface of the hydrocarbon (from one point on the surface to another), or from the surface of the liquid to the tank or tank structure. The discharge may also take place in the liquid beneath the surface.

When charge is produced under conditions where the vapor is the continuous phase, the discharge can theoretically follow a number of different

TABLE 1—POSSIBLE MECHANISMS OF CHARGE GENERATION

Hydrocarbon Moving	Hydrocarbon Stationary
1. Over solid surfaces: Pipes, tank walls, filters, sludge, tank scale	1. Settling of solids: Sludge, tank scale
2. Over or through other liquids: Water or chemicals	2. Settling of liquids: Water or chemicals—gas (air or light hydrocarbon) rising through liquid
3. Hydrocarbon mist through vapor (air and hydrocarbon)	3. Water mist or carbon dioxide snow through hydrocarbon air-vapor

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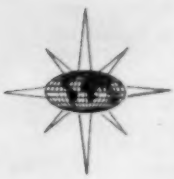

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paths: (1) from mist (hydrocarbon, carbon dioxide snow, liquids, water) to tank; (2) from one part of mist to another part; and, (3) from mist to liquid hydrocarbon. Which, if any, of these discharge paths were involved in the explosions that have taken place is not known.

Judging from the results of this investigation, it appears that many distillate fuels, under service conditions, should produce substantial electrostatic fields. When this is considered in conjunction with the fact that there must have been an extremely large number of cases where an explosive vapor or mist was present, it is remarkable that more explosions have not been encountered.

This then raises the question as to whether the electrostatic fields produced by hydrocarbons are strong enough to produce discharges spontaneously, or whether some triggering mechanism must be present. In some of the explosions a possible triggering mechanism was present, such as gaging or sampling. In other cases some part of an operation might have triggered the discharge without having been recognized.

This would include movement of swing pipes, or the accidental introduction of charge-collecting media, such as metal objects, water, or other materials having higher electrical conductivity than the hydrocarbon. It has also been suggested that external forces, such as cosmic radiation, may have been involved.

The method or methods of solution which are finally applied will be decided by the mechanism of charge production and discharge formation. For example, if the static is produced and discharged within hydrocarbon mists, in some instances additives theoretically would not be of benefit. Either the mist formation would have to be eliminated or the oxygen concentration would have to be reduced to a level which will not support combustion.

Additives would appear to provide a solution to the problem only in the event that the static is produced in, and discharged from, liquid hydrocarbon. Antistatic additives, for example, would probably not reduce static generation in mists formed during overshot filling, steaming, or blanketing with liquid carbon dioxide.

Experimental . . . In view of the urgency of the static-electricity problem, two lines of attack are being followed concurrently in the experimental program. The first involves the determination of the frequency, the location, and the intensity of electrical discharges under actual service conditions. It should then be possible to relate the occurrence of electrical discharges to such factors as fuel properties, handling conditions, humidity, and temperature. The second line of attack involves laboratory and field studies aimed at defining the important fuel and equipment parameters involved in static-electricity production and methods for eliminating charge buildup.

A. Detection of Electrical Discharges

Although electrostatic discharges have been seen in agitators during treating operations and during the loading of tanks, no systematic study has been undertaken to determine under what conditions these discharges occur, where they occur, and with what intensity. A program has been started at one of our affiliated refineries to determine this.

The detection studies are being carried out in large cone-roof tanks (100,000 bbl.), in semiplant (10,000 gal.) and laboratory tanks (55 gal.), and in tank trucks. The fuels being studied include JP-4, heating oil, and diesel oil. In the limited number of tests carried out to date, static-electricity discharges were not heard or seen in any of the tests involving heating oil, diesel fuel, or JP-4. The samples of the fuels being pumped showed little static production in laboratory tests.

In addition to normal tank-filling studies, the radio receiver alone was used during the washing of a large storage tank by spraying No. 2 heating oil, at 1,200 psi., against the wall and floor of the tank. Frequent static discharges were detected during the course of the operation. (The tank had been completely blanketed with carbon dioxide before initiating the washing procedure.) This sample was also found to be a potent static producer in laboratory tests.

B. Static Generation by Liquid Hydrocarbons

In order to facilitate the evaluation of the static-electricity-producing properties of liquid hydrocarbons, a laboratory method was needed which would be simple in operation, use small samples, and in which the apparatus could be readily disassembled and cleaned.

A number of methods were investigated. The most convenient means for producing static was found to be movement of the hydrocarbon over a solid which had a large surface area. Two test methods have been used. In the first, which is referred to as the "laboratory pumping test," the hydrocarbon is continuously circulated through Pyrex glass wool (acting as the charge-separating surface), and the static electricity developed in the system is measured by means of a calibrated spark gap connected between the charge-separating surface and ground.

The spark gap is used in order not to impose a load on the electrical system. The number of 7,000-volt spark discharges across the gap during a 10-minute pumping period is arbitrarily taken as a relative measure of the static-producing tendency of the fuel. The larger the number of discharges, the greater the static-producing tendency of the fuel.

This type of unit can be considered as representing a hydrocarbon being pumped through a large number of small pipes or the settling out of solid materials in a tank, inasmuch as one is the inverse of the other (liquid-solid, solid-liquid).

In the pumping test, the outside of the column and the probe acquire one type of charge polarity or sign. The hydrocarbon leaving the charge-separating area carries a charge of opposite sign. Some fuels leave a positive charge on the glass wool and others a negative charge, depending upon the nature of the impurities that are present.

The second method consists in measuring the streaming current produced when the hydrocarbon is percolated through a Teflon pipe containing a charge-separating solid such as Ottawa sand, tank scale, or stainless-steel Fenske rings. The current is measured by means of a precision micro-microammeter.

A number of refinery products have been evaluated in both the laboratory pumping test and the streaming-current test (stainless-steel Fenske rings). There is a direct relationship between the number of 7-kv. discharges produced in the pumping test and the amount of current generated in the streaming-current test. Thus it appears that both laboratory tests are measuring the same electrical properties of fuels. The laboratory pumping test was used in most of this work.

1. Static production of refinery hydrocarbons and chemicals . . . The static-producing activity of a number of refinery products was measured in the laboratory pumping test. As shown by the values in Table 3, all of the hydrocarbons produced static, although there was a considerable variation in the amount produced.

The aliphatic solvents and lower-boiling hydrocarbons generally produced less static than the higher-boiling products, such as the jet fuels, heating oil, and diesel fuel. In addition to giving a greater number of 7-kv. discharges, the higher-boiling

Congrats and $25 to Robert L. Littler, Kendall Refining Company, Bradford, Pennsylvania, for this quip.

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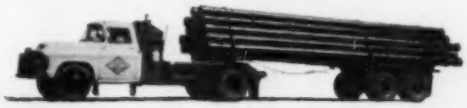

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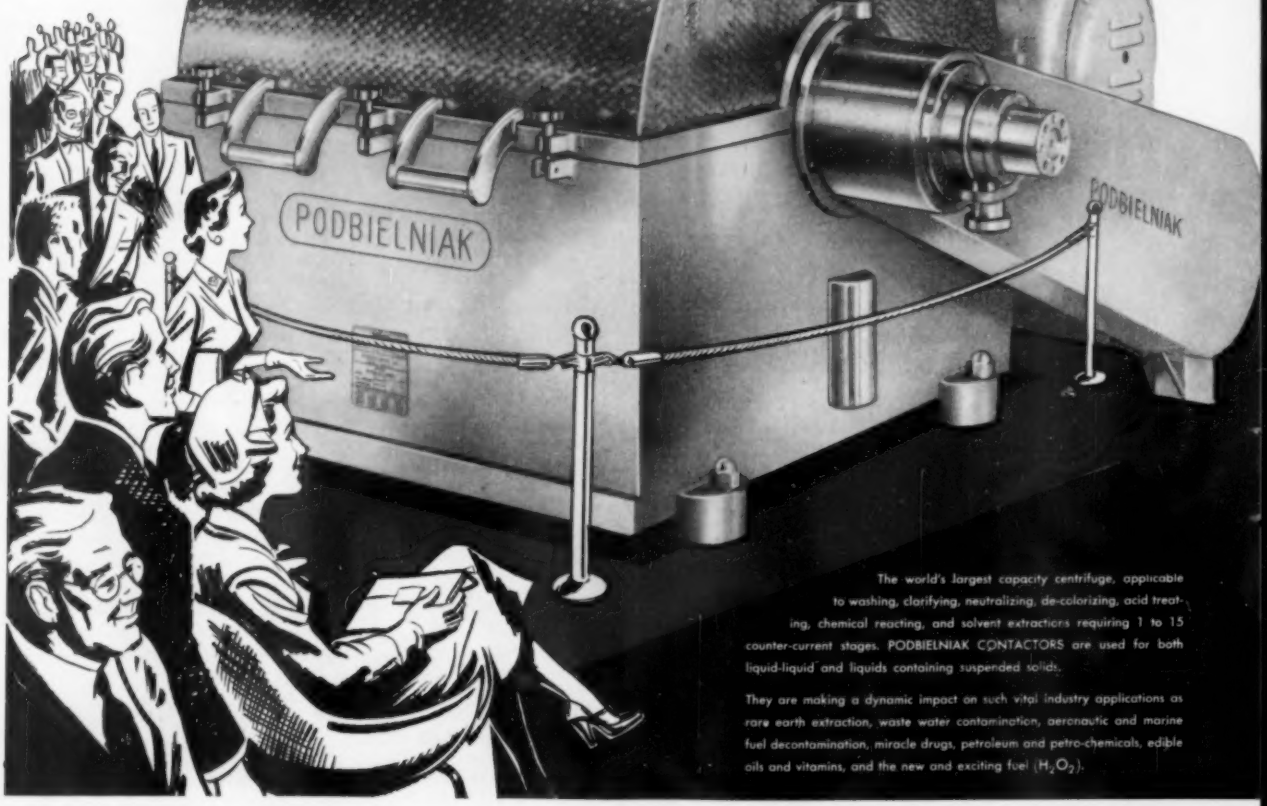

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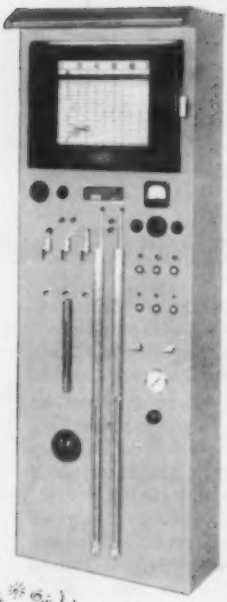

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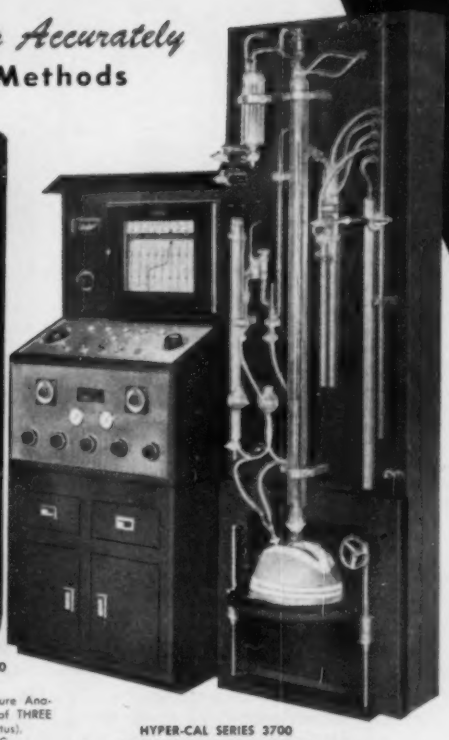

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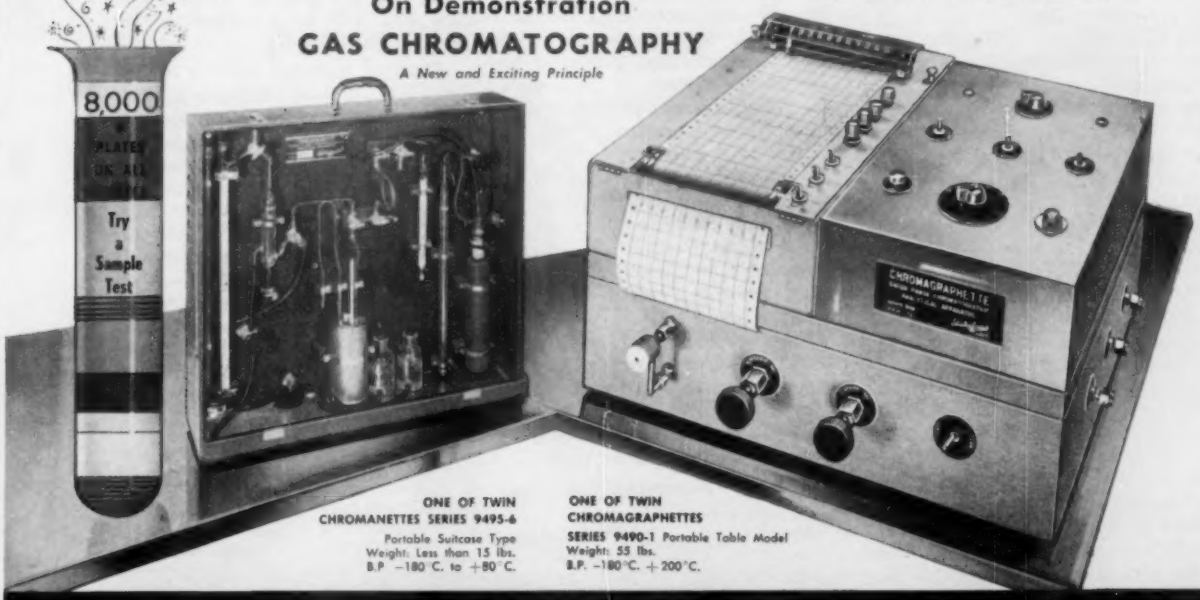

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fuels are capable of producing much higher voltages than the more refined fuels.

The oxygenated solvents, such as isopropyl and decyl alcohols, showed no static formation. For each type of fuel, such as JP-4, there is a wide variation in the static-producing tendency from batch to batch.

It should be borne in mind that the values for the static-producing tendency are relative and not absolute values. In those cases where no 7-kv. discharges are obtained in the pumping test, it should not be assumed that no static would be produced by these fuels.

TABLE 3—STATIC ELECTRICITY OF HYDROCARBONS AND CHEMICAL PRODUCTS

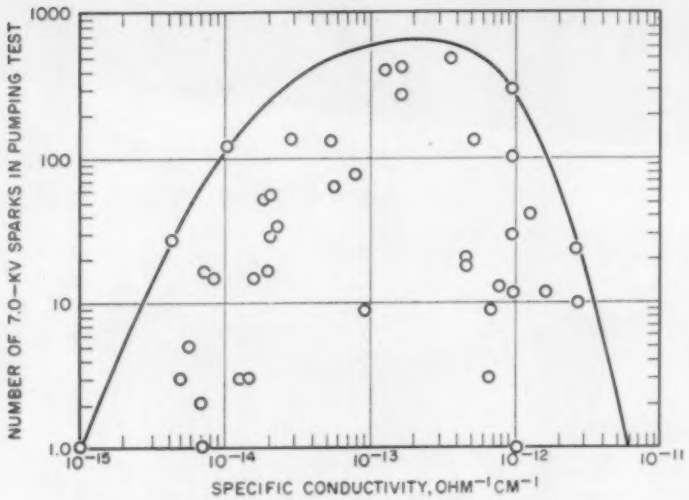
Product—	Discharges (7-kv.)
Isooctane, heptane, tetrapropylene, solvent naphtha No. 1 and No. 7, Varsol No. 2, cetane, refined kerosine	0 to 12
Toluene, xylene	14 to 50
Gasoline (automotive and aviation)	41 to 59
JP-4	1 to 71
Raw kerosine	7 to 82
JP-5	10 to 140
Diesel fuel	166 to 420
Heating oil	5 to 600
Methyl ethyl ketone, isopropyl alcohol, decyl alcohol	0

A slight electrostatic field is produced with pure hydrocarbons, and if the spark gap had been set to discharge at lower potential, discharges would undoubtedly have been obtained with these low-activity fuels.

The values for the very active fuels may be somewhat low since the radio detector indicates that there are frequent internal discharges in addition to the discharges across the gap with these fuels. With a shorter gap, a relatively greater number of discharges might be obtained with these active fuels as compared to the less potent products.

2. Relationship between electrical conductivity and static production . . . In order to determine the relationship between static-electricity production and electrical conductivity, the direct-current (d.c.) conductivity of a large number of hydrocarbons and chemicals was measured. Two methods have been employed. The first, which employs a stainless-steel beaker, is more convenient and rapid and is used when a fairly large sample is available. The second uses a Balsbaugh conductivity cell.

On the basis of laboratory tests, there appears to be a definite relationship between static production and electrical conductivity. Hydrocarbons which have electrical conductivity in the approximate range from 1×10^{-15} ohm^{-1} cm.$^{-1}$ to 1×10^{-11} ohm^{-1} cm.$^{-1}$ produce static in the laboratory test.



STATIC PRODUCTION vs. conductivity, refinery products. Fig. 1.

Those materials which have conductivity values outside this range appear to be relatively inert. This relationship is shown graphically in Fig. 1, in which the curve relates maximum observed charge production to electrical conductivity. Summary data read from the curve are given in Table 4.

The production of static electricity by hydrocarbons appears to depend on the presence of small amounts of contaminants which increase the electrical conductivity. Static production is low at low conductivities, primarily because of the absence of these materials. As the quantity of contaminants increases, charge production and conductivity also increase. As the contaminant concentration is further increased, the competing effect of increased bulk conductivity charge dissipation starts to override the rate of production and, if sufficiently high, charge production cannot attain high levels.

As shown in Fig. 1, at a fixed conductivity level charge production varies widely and thus cannot be defined by conductivity alone. This suggests that the static-producing materials are mixtures having different static production-conductivity relationships.

TABLE 4—SPECIFIC CONDUCTIVITY AND STATIC PRODUCTION

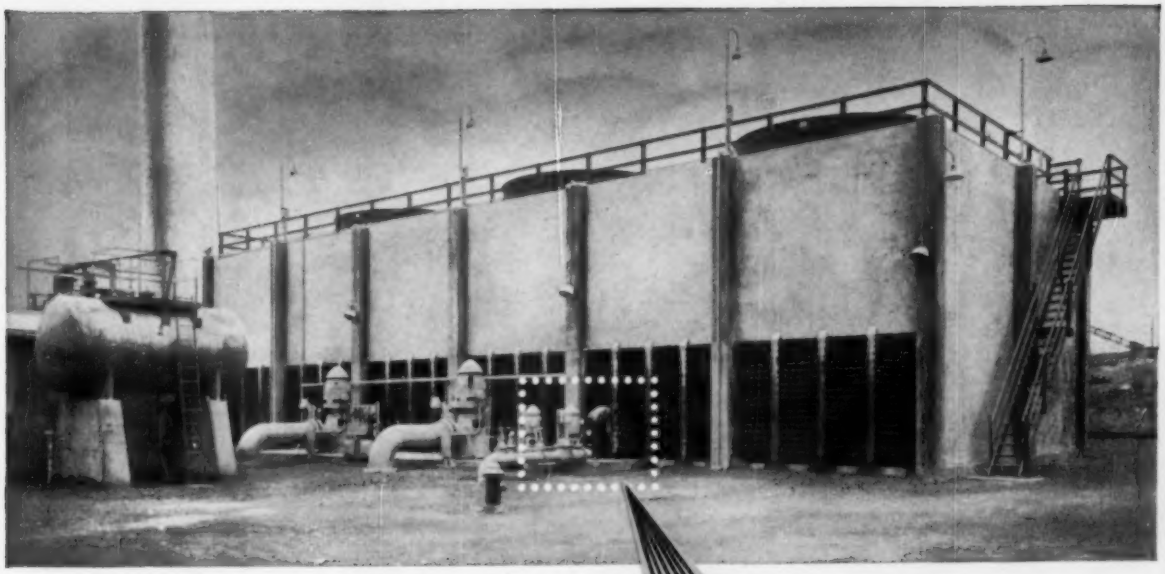
Specific conductivity (ohm^{-1} cm.$^{-1}$)	Laboratory pumping test (7-kv. discharges)
1×10^{-15}	1
5×10^{-15}	35
1×10^{-14}	110
5×10^{-14}	500
1×10^{-13}	600
5×10^{-13}	550
1×10^{-12}	250
5×10^{-12}	2
1×10^{-11}	0

(a) Effect of voltage gradient on conductivity of hydrocarbons: In studies on the specific conductivity of hydrocarbons, it has been noted that the specific conductivity charges, depending on the d.c. voltage applied to the conductivity cell. For example, the specific conductivity measured at 1 volt across the cell was 2 to 20 times the conductivity measured at 500 volts. This point is illustrated by the data in Table 5.

Thus the resistance (inverse of conductivity) of these materials appears to increase as the voltage gradient increases. If this phenomenon is realized under service conditions, it could be an important factor in the mechanism of static production. Under the influence of a self-induced electrostatic field, the resistivity of the hydrocarbon may become high, with an attendant increase in time required for relaxation. The increase in resistance with applied voltage obtained for the jet fuel stocks is also obtained for these same stocks containing various

TABLE 5 EFFECT OF APPLIED D.C. VOLTAGE ON CONDUCTIVITY

	Specific conductivity (σ)$\times^{14}$ at indicated applied voltage		
	1	500	Ratio, $\sigma 1/\sigma 500$
Benzene	4.8	0.52	9.2
Heating oil	8.1	3.9	2.0
JP-5	7.2	0.37	19.5
JP-5	3.2	0.62	5.1
JP-5	1.6	0.52	3.0
JP-4	160.0	32.0	5.0



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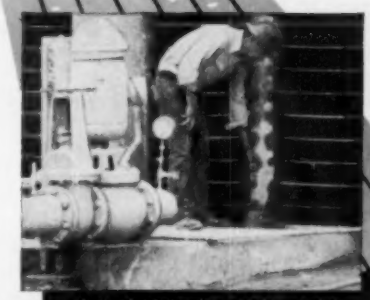

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experimental antistatic additives, although not quite to the same extent.

TABLE 6—EFFECT OF FLOW RATE ON STATIC PRODUCTION

Sample—	Laboratory pumping test (7-Kv discharges) 500 ml. per minute	1,500 ml. per minute
JP-4 (A)	24	138
JP-5 (B)	16	84
JP-5 (C)	8	28
JP-4 (D)	3	14

3. Factors contributing to static production . . . The rate of static production in the laboratory pumping test varies with pumping rate, time of pumping, and temperature. The nature and condition of the charge-separating surface, as well as the presence of contaminants such as water and tank scale, also affect the rate of charge production. A description of the magnitude of these effects is given in the following paragraphs.

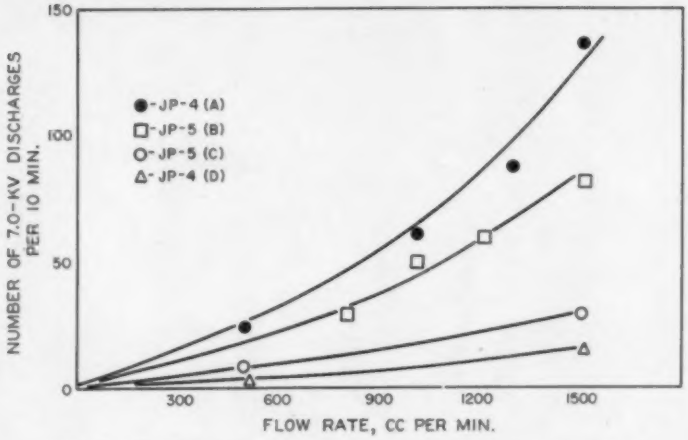
(a) Charge production vs. flow rate: In the laboratory pumping test, charge production increases with flow rate. With different samples of JP-4 and JP-5, for example, an increase in flow rate of from 500 ml. per minute to 1,500 ml. per minute results in about three to sixfold increase in static-discharge frequency, as shown in Table 6. This relationship is illustrated graphically in Fig. 2.

Based on the laboratory results, the recommended practice of using reduced flow rates in the bulk handling of hydrocarbons would directionally favor reduction of the generation of static electricity in the field.

(b) Charge production vs. pumping time: It has been observed that upon prolonged recirculation over the glass wool, highly refined materials such as isooctane, silica-gel-treated jet kerosine, and Hydrofined kerosine, rapidly lose the tendency to produce charge, whereas jet fuels maintain charge production at a high rate. Some samples of raw kerosine showed no charge production initially, but after a several-minute induction period static discharges were obtained at a rapidly increasing rate. The results of these tests are shown in Fig. 3.

TABLE 7—GLASS WOOL AND TANK SCALE AS A CHARGE-SEPARATING SURFACE

	Flow rate (ml. per minute)	Laboratory pumping test (7-Kv. discharges) Tank scale	Glass wool
Jet kerosine	1,500	66	10
Isooctane	1,500	29	1
Jet kerosine	500	27	2
Isooctane	500	8	0

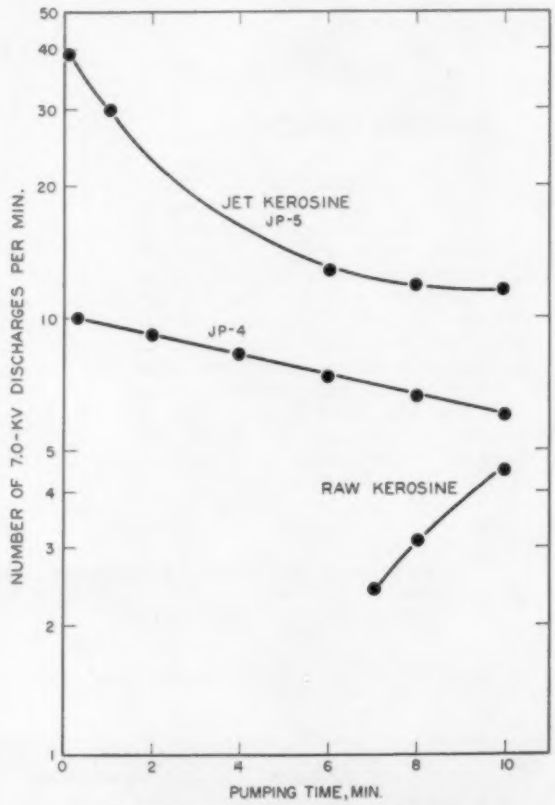


STATIC PRODUCTION vs. flow rate in laboratory pumping test. Fig. 2.

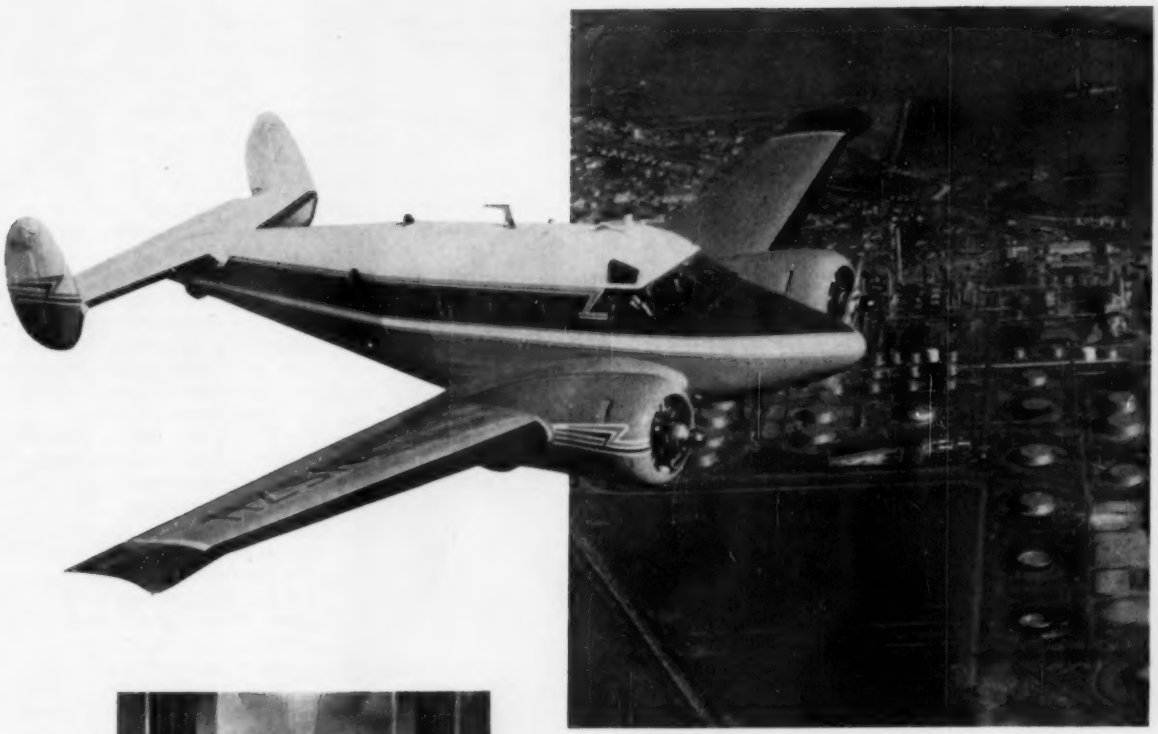
The results on the raw kerosine may serve to explain why, in kerosine treating, strong electrostatic fields were not detected by earlier investigators until after acid treating had been partially completed; i.e., until some of the impurities had been removed from the kerosine.

(c) Nature and condition of charge-separating surface: The charge-separating activity of glass wool was compared with that of tank scale obtained from a kerosine storage tank. The surface presented by the tank scale would be representative of that encountered by refinery hydrocarbons flowing through pipes or moving in storage or blending tanks.

Charge production was found to be substantially greater with tank scale than with glass wool, either with a



STATIC PRODUCTION vs. pumping time. Fig. 3.



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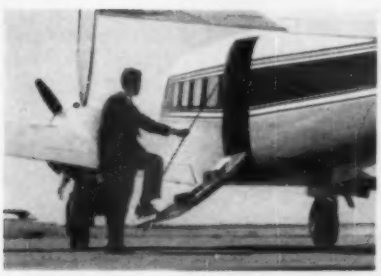

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highly purified hydrocarbon such as isooctane or a less pure material such as jet kerosine (JP-5 type). With both surfaces, jet kerosine was more reactive than isooctane. The polarity of the glass-wool plug and the tank scale during circulation of the hydrocarbon was the same. These data are shown in Table 7. It thus appears that a surface such as glass wool is satisfactory for obtaining the relative rating of the static-producing tendency of hydrocarbons. Glass wool is preferred over tank scale in the laboratory pumping test because the tank scale tends to compact during circulation of the hydrocarbon, making it difficult to maintain a constant flow rate.

When stainless-steel wool is used in place of glass wool, the charge production rate is low as compared to that when glass wool is used. Materials such as activated clay, silica gel, and elemental sulfur, which have strong adsorbing power, serve as effective charge-separating surfaces.

It has been found that fresh glass wool can be preconditioned to give a substantially more active charge-separating surface. This has been done by pumping a relatively large volume of active fuel over the glass-wool plug and then using this preconditioned surface in the laboratory pumping test.

With the pure hydrocarbon, isooctane, static production was increased 14-fold by preconditioning in this manner. A similar effect was observed when the glass wool was preconditioned with the extract from tank scale which contains elemental sulfur and polymeric materials. Illustrative data are presented in Table 8.

TABLE 8—EFFECT OF PRECONDITIONED SURFACE ON STATIC PRODUCTION WITH ISOOCTANE

Treatment of surface—	7-Kv. discharges
None	1
Preconditioned by recirculating 10 gal. of jet kerosine	14
Preconditioned with tank-scale extract	11

These data suggest that, in a preconditioned system, even pure hydrocarbons might produce hazardous amounts of static electricity.

TABLE 9—EFFECT OF DISPERSED SOLIDS ON STATIC PRODUCTION

Sample—	7-kv. discharges
JP-5	15
JP-5 + tank-scale fines	27

(d) Effect of finely dispersed solids and air on static production: Colloidally dispersed tank-scale fines markedly accelerate static production in the laboratory pumping test, as shown in Table 9. Thus it would appear advisable to minimize the pick-up of loose fines in bulk handling of hydrocarbons in the field.

Air also accelerates static production in the laboratory pumping test, particularly when present in a finely dispersed state. Data are presented in Table 10.

In the streaming-current tests also, air has a marked effect on current generation. During the initial stages of the test when the hydrocarbon first enters the charge-separating area, the current production is momentarily 100-fold greater than when steady-state conditions have been established. Similarly, near the end of the test when the last portions of the hydrocarbon leave the unit, a marked rise in current production is obtained.

On the basis of these data, the recommended field practice of minimizing the introduction of air with flowing hydrocarbon would tend to reduce the production of static electricity. Also, the use of low pumping rates at the startup and completion of pumping operations, when air may be present, would appear to be a sound procedure.

TABLE 10—EFFECT OF AIR ON STATIC PRODUCTION
(JP-5; air rate 500 ml. per minute)

Air—	7-kv. discharges
None	7
Large bubbles	12
Finely dispersed	22

(e) Effect of water on static production: The effect of water on the static activity of flowing hydrocarbons appears to be highly variable, depending to a large extent on the concentration and distribution of water within the system. For example, small amounts of water tend to accelerate charge production with jet kerosine in the laboratory pumping test. This has been observed with both water-saturated kerosine and kerosine containing dispersed water. On the other hand, when large quantities of water are present in the pumping-test apparatus, so that the glass wool is wetted by water, charge production ceases altogether. Illustrative data are given in Table 11.

TABLE 11—EFFECT OF WATER ON STATIC PRODUCTION

	7-kv. discharges
No water	60
Water saturation	120
Dispersed water (0.5 per cent)	150
Bulk water (>0.5 per cent)	0

Sufficient field data are not available to establish a quantitative relationship between water and static production. However, it does appear logical that if water is present in a contaminant concentration to the extent that it can activate the charge-separating surface, or if it is a highly dispersed form so that it can act as a charge-separating interface, the production of static electricity will be accelerated.

Although water might decrease charge separation in pipes, upon introduction into tanks the separation and settling of the water will provide a high degree of charge separation. In addition, as mentioned previously, slugs of water thrown to the surface of the hydrocarbon could provide an effective charge collector and discharge mechanism. The role of water is being studied further in large experimental tanks.

(f) Effect of temperature on static production: Static-electricity measurements in the laboratory pumping test indicate that temperature has a marked and variable effect on static production, depending upon the fuel. With some samples static activity decreases with increasing temperature, whereas with others the reverse is true. The results of the tests on samples of JP-4 are given in Table 12.

TABLE 12—EFFECT OF TEMPERATURE ON STATIC PRODUCTION

	Discharges at indicated temperature*		
JP-4 sample	50° F.	80° F.	105° F.
G	3	2	0
H	176	135	10
I	125	118	23
J	153	230	†553

*Discharges detected by radio receiver.
†May include discharges in liquid.

The reason for the variable effect of temperature on static activity is not clear at this time. It does not appear to correspond with changes in conductivity at different temperatures. However, it may be associated with solubilization or change in chemical composition of the static-producing contaminants. This is suggested by the fact that the polarity of the fuel is reversed, in some instances, at different temperatures.

Molecular association may also be important. Future work on this phase of the problem will include other fuels and different types of charge-separating surfaces. Streaming-current measurements will also be made over a wide range of temperature.

4. Effect of storage on static activity . . . Since there were indications that the static-producing tendency of distillate fuels increased during nor-

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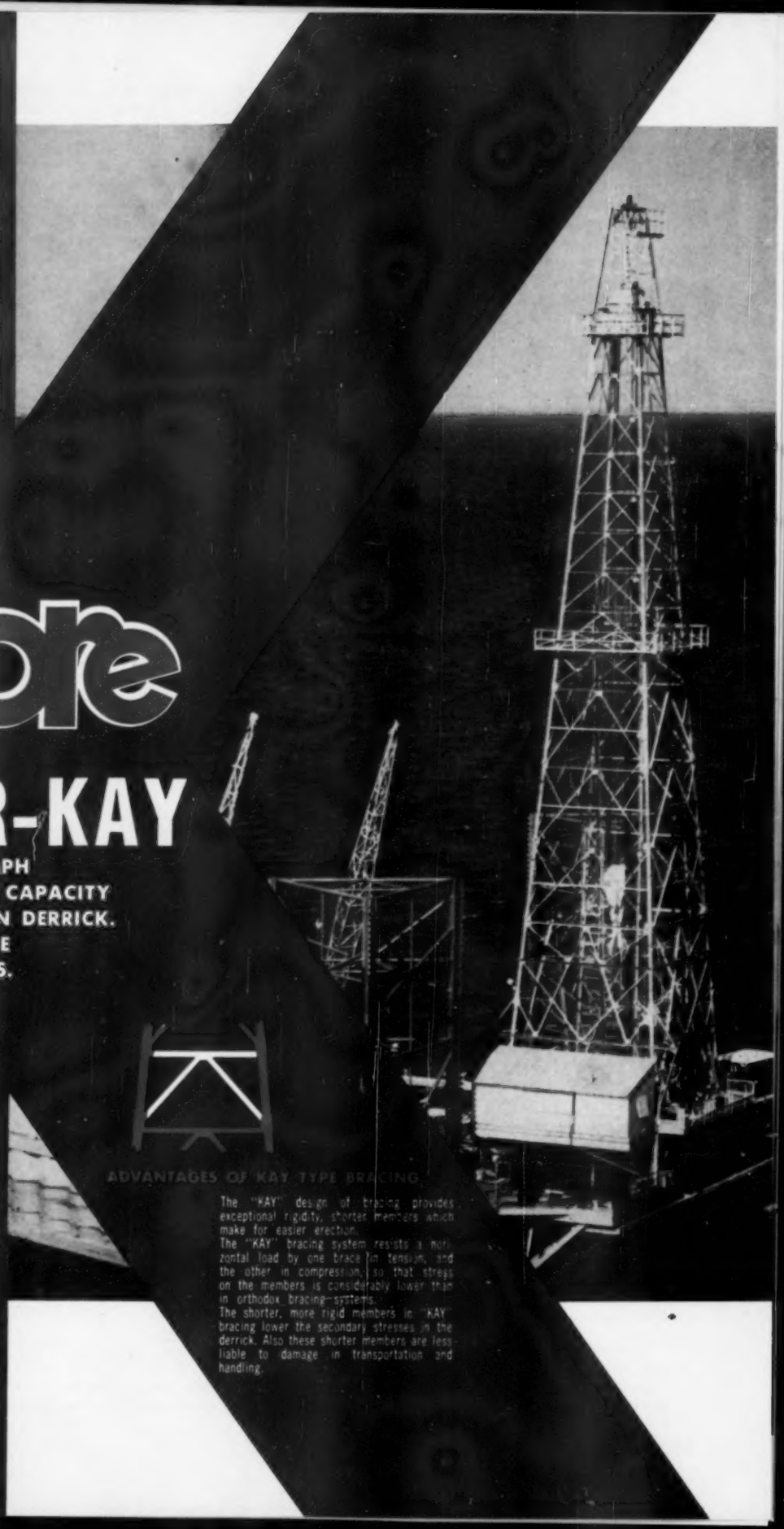

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mal storage, some controlled storage tests were carried out to establish this effect more definitely. As shown by the data in Table 13, an uncompounded heating oil, when stored at 170° F., increased in activity sixfold during a 3-week storage period.

TABLE 13—EFFECT OF ACCELERATED STORAGE ON STATIC PRODUCTION

(Heating oil stored in 50-gal. drums at 170° F.)

Storage time (days)	Laboratory pumping test (7-kv. discharges)	Potential gum (mg. per 100 ml.)
0	21	0.8
9	54	2.4
20	131	6.2

During this time the oil became darker in color and somewhat turbid. Gum values also increased.

The effect of aging on electrostatic-charge production is less pronounced with fuels such as JP-4 than with heating oil. In an attempt to accelerate the effect of storage on JP-4 properties, a series of production samples was stored in rusted iron pots for 2 weeks.

The rusted interior surface of the pots was freshly prepared just prior to the stability tests. With all JP-4 samples, the static activity disappeared or was markedly reduced. Gum content of the fuel also decreased. Data illustrating these points are given in Table 14.

It appears that, under these storage conditions, the prostatic components were adsorbed from the fuel by the rusted iron surface.

5. Effect of high-temperature treatment . . . To determine the effect of fuel residence at high temperature on static generation, production samples of JP-4 were run in the C.F.R. fuel coker test. In this test, jet fuels are subjected to the temperatures, pressures, and heat-exchanger residence times such as may exist in an operating jet engine.

TABLE 14—EFFECT OF FUEL STORAGE ON STATIC PRODUCTION

JP-4 sample	Before storage: No. of 7-kv. discharges	Before storage: Potential gum (mg. per 100 ml.)	After storage*: No. of 7-kv. discharges	After storage*: Potential gum (mg. per 100 ml.)
A	8	1.0	0	0.4
B	27	0.4	0	0.2
C	40	1.0	4	0.8

*Stored in prerusted iron pots, at 125° F. for 13 days.

The fuel passes through the fuel coker system on a once-through basis at a rate of 6 lb. per hour. For JP-4, the preheater and filter units are maintained at 300° and 400° F., respectively. Residence time in the hot section of the coker is approximately 15 seconds. Laboratory static measurements on the samples showed that the C.F.R. fuel coker treatment increased the static activity to about 2½ times that of the original fuels.

The actual static activity of the heat-treated fuel is probably even greater than indicated since some static-producing materials may have been removed by the filters within the fuel coker equipment. It may be noted that the most active static producer also gave the highest tube deposit rating. These data are summarized in Table 15.

TABLE 15—EFFECT OF HIGH-TEMPERATURE TREATMENT ON STATIC PRODUCTION

JP-4 sample	7-kv. discharges: Before C.F.R. fuel coker test	7-kv. discharges: After C.F.R. fuel coker test	C.F.R. fuel coker test: Pressure drop acress filter (in. of Hg)	C.F.R. fuel coker test: Tube deposit rating
A	5	13	0	1
B	13	30	0.25	1
C	81	190	0	3
Requirement:			10 max.	2 max.

C.R.C. deposit code: 0—No visible deposits. 1—Visible haze or dulling, but no visible color. 2—Barely visible discoloration. 3—Light-tan to peacock stain. 4—Heavier than No. 3.

These data suggest that there may be a correlation between tendency of fuels to produce deposits at elevated temperatures and static activity, and this is being studied in more detail with additional fuels.

6. Effect of ultraviolet and gamma radiation on static production . . . Laboratory tests have also been conducted on four refinery samples of JP-4 to determine the effect of ultraviolet radiation on static activity. With three of the samples, static activity increased markedly during storage, but one sample (sample D) became practically inactive. In all cases, potential gum values increased and the samples became turbid.

It appears that in sample D, which became inactive, the static-producing components coagulated and settled out during irradiation. This is confirmed by the fact that when a trace of the storage sediment was wiped on the glass-wool plug and the sample rerun in the pumping test, static activity was restored to almost the same level shown by the original fuel. The results of analytical studies on this precipitate are given in the following section of this paper.

When gamma radiation is employed in place of ultraviolet light, the charge-producing tendency of JP-4 fuels is generally increased. However, only trace amounts of insoluble products are formed during gamma irradiation. Illustrative data are given in Table 17.

TABLE 16—EFFECT OF ULTRAVIOLET RADIATION ON STATIC PRODUCTION

JP-4 sample	Before exposure: No. of 7-kv. discharges	Before exposure: Potential gum (mg. per 100 ml.)	After exposure*: No. of 7-kv. discharges	After exposure*: Potential gum (mg. per 100 ml.)
A	4	0.4	25	7.4
B	27	0.4	46	6.0
C	71	0.4	132	16.4
D	40	1.0	1	17.1

*Exposed to sunlight for 10 days; tests on supernatant liquid.

TABLE 17—EFFECT OF GAMMA RADIATION ON STATIC PRODUCTION

JP-4 sample	Before irradiation: No. of 7-kv. discharges	Before irradiation: Potential gum (mg. per 100 ml.)	After irradiation*: No. of 7-kv. discharges	After irradiation*: Potential gum (mg. per 100 ml.)
E	8	1.0	113	17.0
F	18	0.4	81	13.6

*Glass bottles: 63.1 hours at 75° F.; 190,000 roentgens per hour; 9.25-cm. radiation distance.

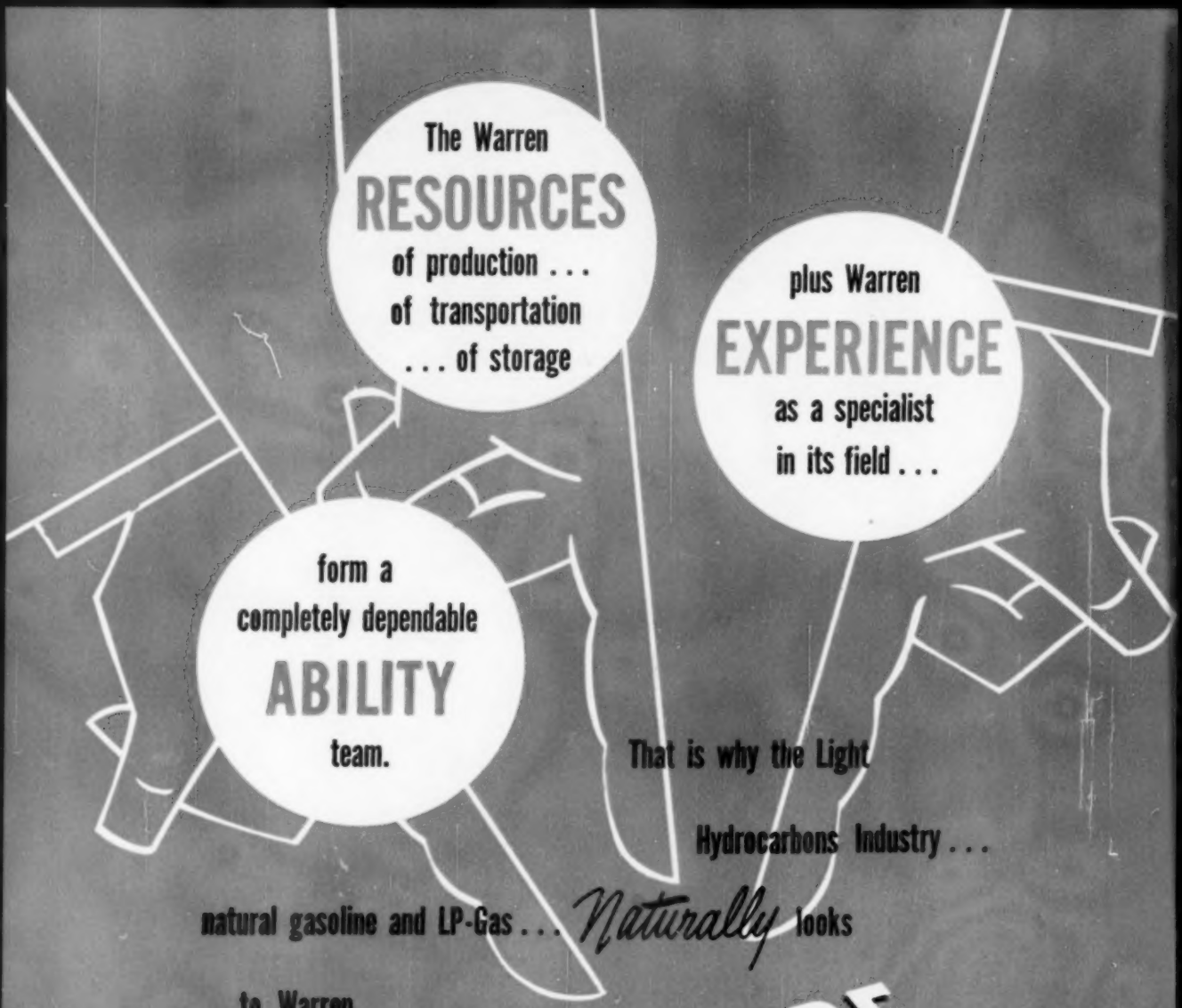
The effect of various types of radiation on other fuels is under study.

7. Nature of contaminants . . . In general, the more potent static-producing hydrocarbon fuels contain a larger amount of colloidal material or macromolecules, as indicated by light scattering and electron microscope measurements, than the less active products.

Small amounts of these colloidal materials can be recovered by ultrafiltration. They are light-brown solids which are soluble in organic solvents. Emission spectrographs show only traces of metals. The pro-static contaminants can also be removed from fuels by silica-gel or clay percolation.

Analyses of these extracts show the presence of sulfur and nitrogen compounds, carbonyl linkages (ketones, aldehydes, carboxylic acids), and polynuclear aromatic hydrocarbons.

Somewhat larger amounts of contaminants were recovered in the experiments in which JP-4 was irradiated with ultraviolet light. It will be recalled that, during the course of the irradiation, a precipitate formed which was found to be a very potent static producer. The precipitate, which was obtained in 0.05 per cent yield, has



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been analyzed and the results are given in Table 18.

This material is a highly oxidized organic polymer containing appreciable amounts of sulfur and nitrogen. It is somewhat unstable, changing in appearance and solubility characteristics upon standing. An emission spectrograph of the precipitate showed that the ash resulted from the presence of iron.

TABLE 18—ANALYSIS OF PRECIPITATE FROM ULTRAVIOLET IRRADIATION OF JP-4

Element—	Per cent by weight
Carbon	57.32
Hydrogen	6.60
Oxygen	24.19
Sulfur	5.07
Nitrogen	3.59
Ash	0.09

If if is assumed that the unit structure contains one sulfur atom, the empirical formula becomes:

$$C_{30}H_{41}O_{0.4}N_{1.6}S$$

Studies are in progress to define further the composition of this pro-static contaminant.

The high sulfur content of the precipitate is not unexpected in view of the fact that the fuel itself contained 0.08 per cent sulfur. In this connection, it has been observed that, in general, the most active static-producing fuels have sulfur content greater than 0.05 per cent.

Thus it appears that both the static activity and storage stability of a fuel may be related to its sulfur content, and this is being studied further. The role of naturally occurring nitrogen compounds is also being investigated.

8. Methods for removing contaminants . . . The charge-producing tendency of hydrocarbon fuels can be reduced by ultrafiltration, by Hydrofining, or by silica-gel or clay percolation. Repeated filtration of JP-4 or JP-5 through micronite filters of 0.5-μ pore size generally reduces turbidity and static production only by 30 to 60 per cent.

Silica-gel or activated-clay percolation is a more effective means of reducing the amount of impurities, although fairly large treats are necessary. All these methods also reduce electrical conductivity.

Typical results are given in Table 19.

Although these methods cause substantial reductions in the static-producing tendency of hydrocarbons, they would be practical solutions only where the purified products could be handled in entirely clean systems,

TABLE 19—METHODS FOR REMOVING STATIC-PRODUCING CONTAMINANTS FROM JP-5

Treating procedure—	Laboratory pumping test (7 kv. discharges)	Specific conductivity $\times 10^{12}$ (ohm^{-1} cm.$^{-1}$)
None	40	1.8
Silica-gel percolation	0	0.005
Clay contacting	0	0.009
Hydrofining	5	0.005
Ultrafiltration	19	0.013

since exposure to contaminants could readily restore their activity.

9. Synthetic pro-static agents . . . In the course of experimental work, some materials have been found which accelerate the generation of static electricity in the laboratory pumping test. These include asphalt and various organic compounds.

Only small amounts (0.001 to 0.0005 per cent) of asphalt are required to greatly increase the static activity of jet fuels. Naphtha fractionation of this asphalt yields approximately 10 per cent asphaltenes (naphtha-insoluble) and 90 per cent oil-resin mixture (naphtha-soluble), and both of these fractions markedly accelerate static generation in the laboratory pumping test.

The naphtha-insoluble fraction appears to contain the more potent static-producing materials, being roughly 10 times more potent than the naphtha-soluble fraction. In a pure hydrocarbon, such as isooctane, asphalt has only a slight pro-static effect. These data are presented in Table 20.

As a result of studies of asphalt, it is now possible to prepare fuels having a range of static-producing activity and electrical conductivity. This reduces the amount of test work previously required in selecting suitable samples for larger-scale investigations.

TABLE 20—EFFECT OF ASPHALT ON STATIC ACTIVITY

Blend—	Laboratory pumping test (7-kv. discharges)	Specific conductivity $\times 10^{12}$ (ohm^{-1} cm.$^{-1}$)
JP-5	4	0.011
JP-5+0.005 per cent asphalt*	130	0.50
JP-5+0.005 per cent naphtha-soluable asphalt	131	1.90
JP-5+0.0005 per cent naphtha - insoluble asphalt	112	1.20
JP-5+0.005 per cent naphtha - insoluble asphalt	2	5.0
Isooctane	0	0.0008
Isooctane+0.0005 per cent asphalt	1	0.0084
Isooctane+0.005 per cent asphalt	2	0.21

*Bachaquero: 88° F. softening point; straight reduced flux.

The organic compounds which increase static production are, in general, materials which show a fairly high degree of ionization. These include acids and salts, as may be noted from the data presented in Table 21. These data support the theory that one of the factors involved in the generation of static electricity is the presence of small amounts of ionizable contaminants.

Light-scattering measurements on the blend of trichloracetic acid in clay-treated JP-5 showed that no insoluble materials were present. It thus appears that the presence of colloidal material is not essential for static production.

TABLE 21—PRO-STATIC COMPOUNDS

	Pumping test 7-kv. discharges
JP-5	4
JP-5+0.01 per cent trichloracetic acid	40
JP-5 (clay-treated)	0
JP-5 (clay-treated)+0.0005 per cent trichloracetic acid	259
JP-5+0.01 per cent methyltriamylammonium-p-toluene sulfonate	300
JP-5+0.01 per cent tetra- (2-hydroxypropyl)-ethylenediamine	200

10. Mechanism of charge separation . . . The experimental work described in this paper supports the conclusion that the production of static electricity in liquid hydrocarbons depends first on the presence of ionizable material in the system. These impurities can be present in the fuel, or derived from the surface over which they are flowing, or both. The proper concentration of such impurities is present in many distillate fuels.

In commercial fuels, static-electricity production is associated with the presence of organic colloidal materials. Whether the colloids themselves are ionized or whether ions of lower molecular weight are adsorbed on the colloids is not known. The presence of the colloids, however, does not appear to be essential to the production of static electricity.

The second requirement is the presence of a surface, e.g., the interior of a pipe, on which the ions can be adsorbed. The greater the adsorbing power of the surface, the more effective the production of static electricity. The solid surface will have a greater affinity for one of the ions of the pair than for the other, e.g., the positive ion in preference to the negative ion.

If the hydrocarbon has low electrical conductivity and the flow rate is sufficiently high, the less strongly

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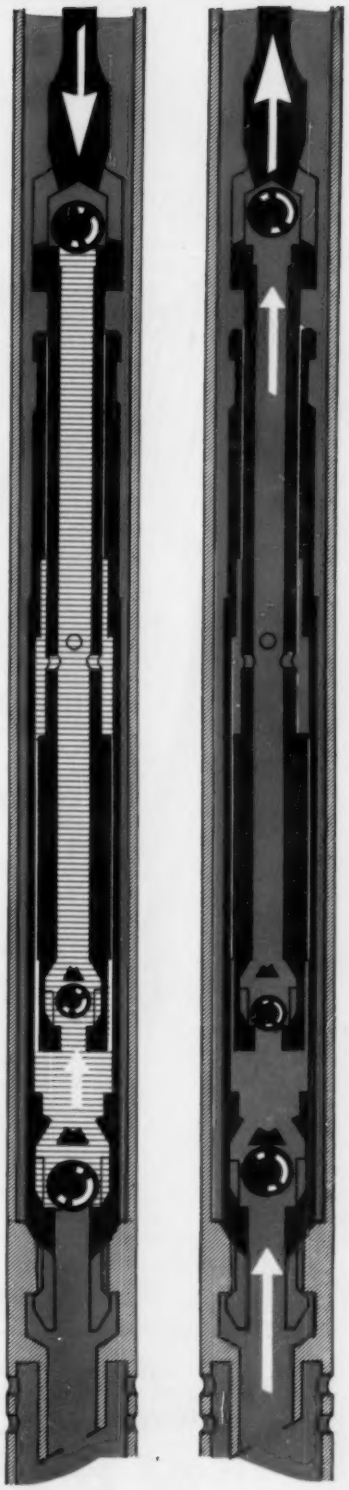

On the upstroke, fluid and gas enter the pump through the standing valve into the full area of the barrel underneath the plunger. This is the first stage chamber. At the beginning of the downstroke, the top traveling valve closes, and the gas is compressed and the fluid displaced into the second stage chamber which is the annular area between the hollow polished rod and the barrel above the plunger. On the subsequent upstroke the top traveling valve opens and the annular chamber discharges the fluid and compressed gas into the tubing.

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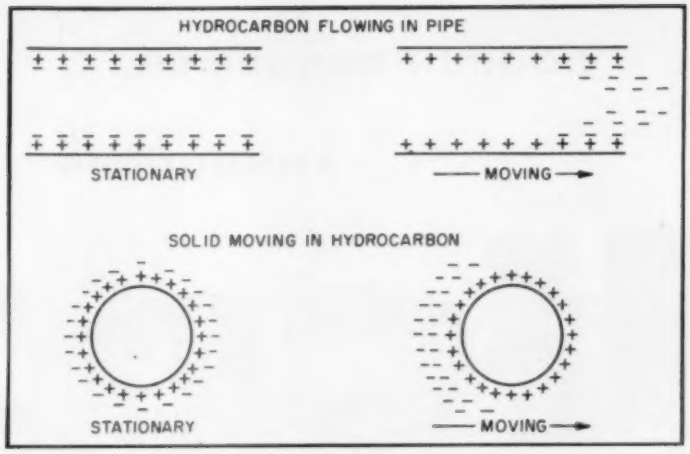


TWO TYPES of charge separation. Fig. 4.

adsorbed ion is swept away and electrostatic potentials are set up. A graphical illustration of this type of charge separation is given in Fig. 4.

For a system involving the movement of sludge particles or other suspended material through the hydrocarbon, e.g., settling in a storage tank, charge production may also be obtained. In this case, the suspended particles perform the same function as the pipe wall. This type of charge separation is also illustrated in Fig. 4.

As mentioned previously, the presence of colloidal materials appears to be an important factor in regard to charge production with commercial fuels. In general, the electrical conductivity of these fuels is somewhat higher than would be expected from the low concentrations of impurities that are present. Similarly, the addition of asphalt to commercial fuels produces a larger increase in conductivity than would be expected from electrostatic dissociation (classical ionization).

These results may be related to the phenomenon observed during previous investigations on liquid dielectrics.[2] In this work, it was found that the electrical conductivities of heterogeneous systems were much greater than could be ascribed to simple ionization mechanisms, and that the region of high conductivity coincided with the formation of emulsions and gels. This has been referred to by some investigators as "colloid ionization."

On theoretical grounds, charge separation should take place more readily if the ionizing molecule is large and if resonant structures within one of the ions are possible. As a consequence of the resonance, the charge of the ion would be spread over a large area and the ionization potential decreased.

C. Discharge of Static From Liquid Hydrocarbons

The electrical charge accumulated in a liquid hydrocarbon can, theoretically, form spark discharges at the surface of the liquid or can discharge internally through the liquid. The results of studies on the mechanism of the discharge formation, given in the following sections, have shown that both of the routes of discharge are possible.

1. Discharges from liquid surfaces . . . It has not been possible in laboratory-scale equipment (up to 55-gal. capacity) to produce high-energy static discharges spontaneously from the surface of liquid hydrocarbons, even with the most active fuels. The introduction of a sharp grounded probe in the vicinity of the surface does not produce a visible spark; instead, the surface of the liquid under the probe peaks up to a point and hydrocarbon collects on the probe. Apparently a continuous corona-type discharge drives a fine stream of hydrocarbon to the probe.

If, however, a charge-collecting device—such as a metal screen floating on the surface or a metal plate immersed in the liquid—is present, and this is connected to a spark gap in the vapor space, explosion of JP-4 can be obtained repeatedly. A sketch of a charge-collecting device is shown in Fig. 5. In this equipment, when pumping active samples of JP-4 or heating oil at a flow rate of ½ g.p.m. through a 1-in. glass pipe (containing a plug of tank scale or glass wool), discharges of approximately 20 millijoules are obtained at 30-second intervals.

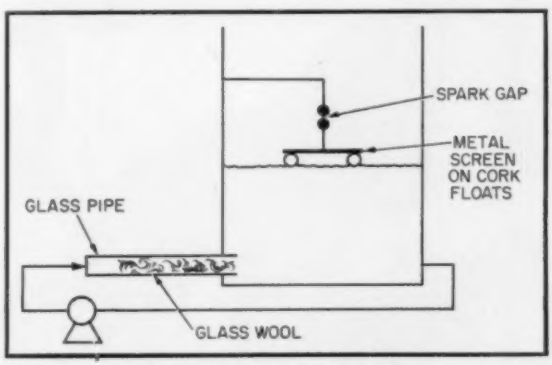
The Bureau of Mines has reported that discharges having an energy content of 0.2 to 0.3 millijoule will ignite hydrocarbon air-vapor. Thus in small equipment, at low flow rates, more than sufficient quantities of electricity to initiate combustion can be obtained.

Under service conditions, charge accumulators such as the floating metal screen are generally not present. However, metal objects may, in some instances, be introduced accidentally, and slugs of water or of other high-conductivity materials reaching the surface of the hydrocarbon might serve as charge collectors and provide a path for discharge.

Because it had not been possible to produce visual discharges spontaneously from the surface of hydrocarbon liquids, some experiments were carried out in which d.c. voltage was applied to a sample of JP-5 in order to determine the conditions under which discharges from the surface of hydrocarbon fuels occur.

In the initial experiments, no sparks were obtained between the surface of JP-5 (specific conductivity 2.7×10^{-14} ohm^{-1}cm^{-1}) and an electrode suspended above the surface, at potentials up to 25,000 volts. Apparently, the charge density on the surface was insufficient to support spark discharges.

It was found, however, that if the surface of the fuel was highly curved, sparks occurred at a potential of



AUTOIGNITION of JP-4. Fig. 5.

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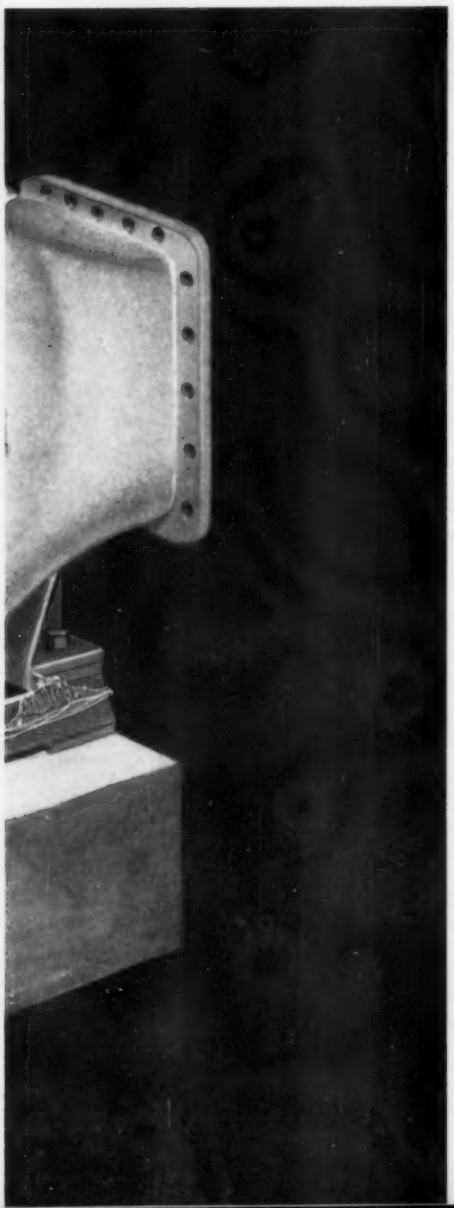

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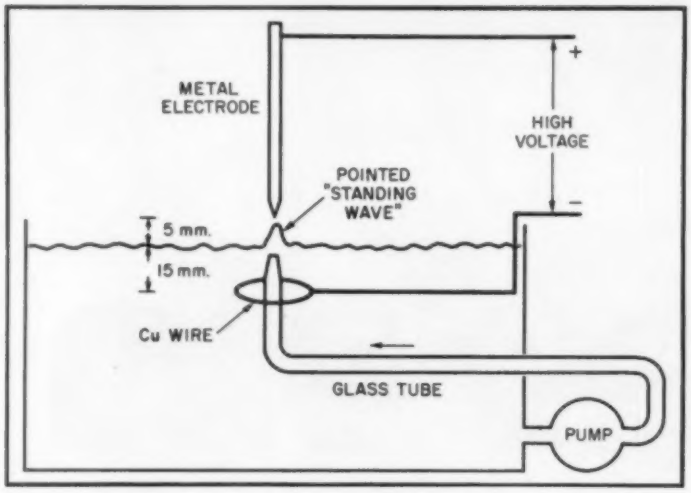


FORMATION of sparks from the surface of JP-5. Fig. 6.

18,000 volts. The apparatus is shown in Fig. 6.

A small stream of the fuel was pumped from the vessel and was jetted upward beneath the surface, causing the surface to rise to a point as shown in the figure. Under these conditions, many small sparks jumped between the electrode and the liquid point.

The sparks were estimated to be approximately 0.5 mm. in length. As the electrical conductivity of the hydrocarbon was increased, the formation of discharges from the surface took place more readily. When the JP-5 was replaced with water, discharges several millimeters in length were obtained.

It is known that electric charges concentrate in the region of greatest curvature. Since the liquid surface in a tank being filled at a high rate would probably have waves, ripples, or standing waves of high curvature, it appears that hydrocarbons could be ignited by sparks jumping from these projections to an object having a different potential.

Waves moving across the surface of a charged liquid could carry part of the surface charge to the wall of the tank. This might be advantageous or disadvantageous. A succession of pebble-in-a-pond waves, originating in the center of a tank and moving concentrically to the wall, might discharge a charged-liquid surface safely.

On the other hand, a wave forced into irregularity by the confines of the tank, or by other waves, might concentrate the electric charge in a small area near the wall, resulting in a spark.

During the course of the experiments on the discharge mechanism it was noted that, under the influence of a strong electric field, the surface of the liquid is violently agitated. It also appears that the surface tension may be lowered, with a resultant increase in vaporization of the fuel and tendency to form mists and fogs. Thus, under the influence of the electrostatic field, the tendency of a fuel to produce an explosive vapor or mist may be greatly increased.

2. Discharges within liquid hydrocarbons . . . In previous work on the mechanism of electrostatic discharges, very little consideration has been given to the possibility of discharges occurring in the liquid hydrocarbon. In this connection, it has been found the under some conditions discharges occur within the body of the hydrocarbon, so that in the presence of air submerged explosions could, theoretically, occur.

In these studies a large pumping unit of approximately 15-gal. capacity was used. Ten gallons of heating-oil base (specific conductivity 2×10^{-13} $ohm^{-1}cm^{-1}$) was recirculated through a glass-wool plug in the 1-in. glass fill pipe at the rate of 1 g.p.m. Initially, charge production was only moderate.

However, on continued pumping, glass wool gradually darkened and developed a very strong electrostatic field. At the same time, intense electrical discharges started both within the liquid in the fill pipe and along the outside of the pipe. These discharges appeared to originate primarily in the darker-colored regions of the glass wool and fired in the direction of the tank structure. In some instances, they were as much as 3 in. long within the liquid and 6 in. long on the outside of the fill pipe.

These larger discharges could correspond to potentials as high as ½ million volts. This phenomenon appeared to be accentuated by the presence of dispersed air or nitrogen. In a number of instances, coincident with some of the more intensive discharges, extensive fracture of the fill pipe occurred.

The heating oil used in the original experiments showed high static-producing potency in the small laboratory pumping test and contained a fairly high concentration of insolubles. Less active heating oils which do not show internal discharges can be made to do so by the addition of small amounts of asphalt. A limited number of JP-4 fuels have also been tested in the larger pumping unit, but no discharges within the liquid were observed unless a pro-static agent, such as asphalt, was added.

The electrical discharges within the liquid hydrocarbon appear to result from an autocatalytic process. The discharges seem to accelerate the formation of products on the charge-separating surface which, in turn, are active charge producers. This cycle then continues until extremely high potentials are developed.

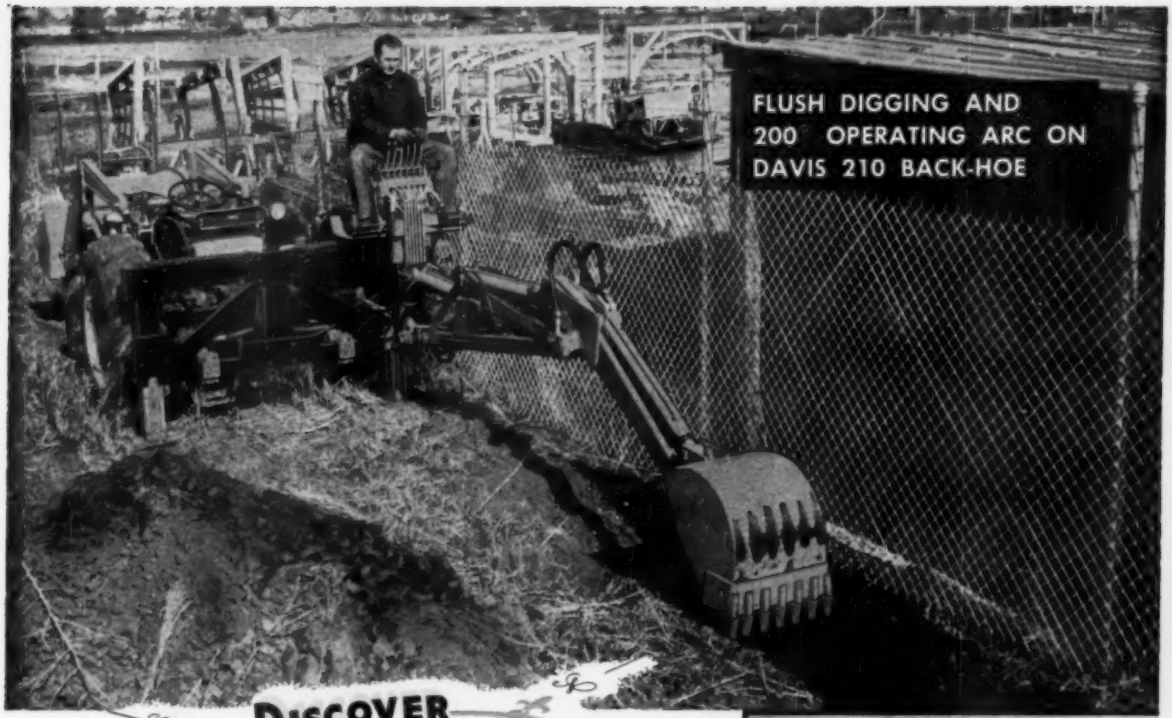
A few milligrams of the deposits on the glass wool from the heating-oil experiments was recovered by washing with heptane, in which the deposits were insoluble. The deposits contained 2.5 per cent ash, with sodium as the major constituent, together with a minor amount of silica and trace amounts of several metals.

Since the silica content is low, it appears that the sodium was derived from the fuel and may represent traces of treating reagent. Further quantities of these deposits will be prepared so that more complete analyses can be carried out.

The internal discharges are frequently accompanied by the emission of rather intense white light. This is believed to be due to irradiation of some of the aromatic hydrocarbons in the fuel with ultraviolet light (from the spark discharges), with the result that visible light is emitted.

In some of the pumping tests, the discharges appear to originate at a spot on the inside wall of the glass pipe and may persist at this point for several minutes. Frequently a small pinhole will develop at this point, through which the discharge will pass to the outside. In those instances where massive discharges break the glass pipe, the fracture appears to originate at one of these pinholes.

It is not known whether the fracture is caused by thermal shock or by low-order explosions of light hydrocarbon produced by cracking of



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the hydrocarbon in the electrical discharges.

Voltages produced during recirculation of JP-4 jet fuel at 0.5 ft. per second through the horizontal pipe containing the glass wool, as described previously, were measured with an electrometer having 10^{14} ohms input resistance. In some cases, the maximum meter reading (20,000 volts) was exceeded.

To get some idea of the maximum potential being produced, potentials were measured between two metal straps moved along the glass tube; they are shown by the horizontal bars in Fig. 7. There was an interesting reversal of polarity at about 10 in. from the drum, the point at which the circulating JP-4 first encountered the glass wool. The upper curve shows the calculated potentials from the drum to the points shown (obtained by adding up the potentials measured between the points); voltages of approximately 36,000 are indicated.

Voltages were also measured from the drum to points along the pipe after removing the glass wool. The maximum voltage in this case was 750 volts.

It is of interest that the potentials built up by pumping JP-4 fuel can, in some situations, require a long time to be dissipated. After stopping circulation of JP-4 in the experiments described in the foregoing, discharges in the glass wool were audible for 20 to 30 minutes and a Keithley electrometer fitted with a static-electricity detector showed the glass wool to be "hot" for upwards of an hour. This means that surfaces of dielectric nonconductors may be potentially dangerous for a considerable period of time after pumping has been stopped.

While the exact mechanical conditions used in this large laboratory pumping equipment may not be encountered in the field, the basic requirement of an electrostatic field of localized high intensity does appear feasible and, as a result, submerged discharges could be possible. These observations may serve to explain some of the low-order explosions which have occurred during the filling of tanks, or some of the rumbling noises which have been reported prior to explosions described in the field.

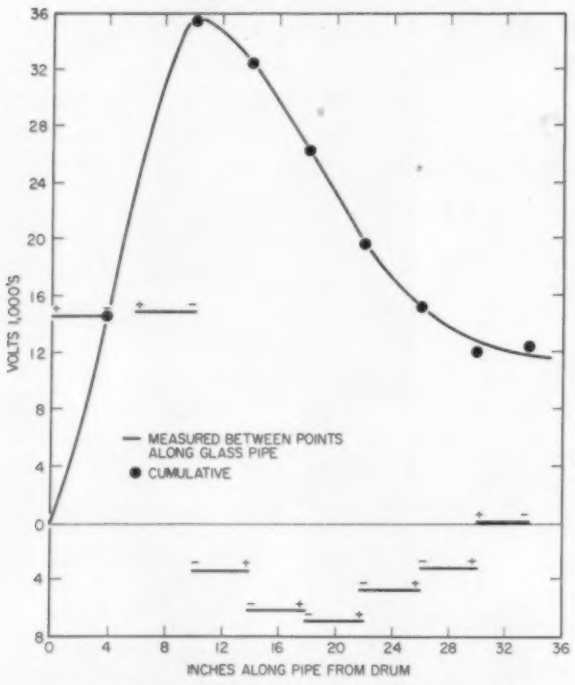
a. Sparking potentials in JP-5: The occurrence of sparks within hydrocarbon liquids in laboratory tests made it of interest to determine minimum sparking potentials in jet fuels.

In a sample of JP-5, the voltage required for successive sparks was not reproducible. It generally increased with successive sparks, as shown in Fig. 8. At each spark, gas was evolved and a fiber formed between the balls of the spark gap. Later sparks apparently avoided the fibers and took a longer path, which could explain the increase in voltage requirement. It is postulated that the fibers were a polymer, such as cuprene, and that the gas represented hydrocarbon degradation products.

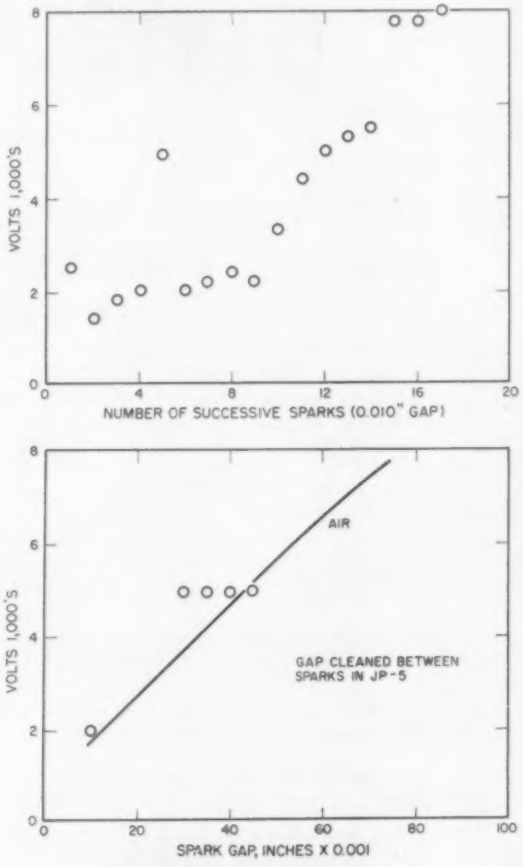
When the gap was cleaned and polished between sparks, the results were more reproducible. As can be seen from Fig. 8, the minimum sparking potential for this sample of JP-5 (specific conductivity 2.7×10^{-14} $ohm^{-1}cm^{-1}$) is approximately the same as for air. The sparking potential varies with the conductivity of the fuel. With fuels having lower conductivity than the JP-5 used in these experiments, a greater potential is required to produce a visible discharge.

D. Static Production by Hydrocarbon Mists

The production of static electricity by movement of suspended particles (liquid or solid) through gases has long been known. It is also known that clouds, mists, and sprays are



VOLTAGES produced by pumping JP-4 jet fuel. Fig. 7.

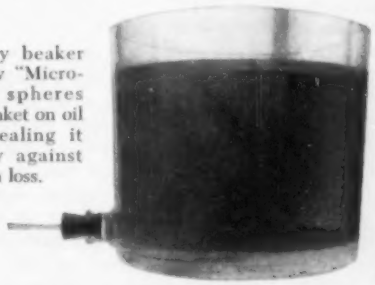


SPARKING potentials in JP-5. Fig. 8.

In this "Sohio" tank farm, evaporation loss has been sharply reduced by the use of a layer of "Microballoon" spheres. Capacity of the farm is 400 thousand bbls., four tanks operating on approximately a 7-day cycle with 7 RVP oil. The fifth tank handles 4 to 5 RVP oil on a 23-25-day cycle. Pipeline rate is 40 thousand bbls. per day.

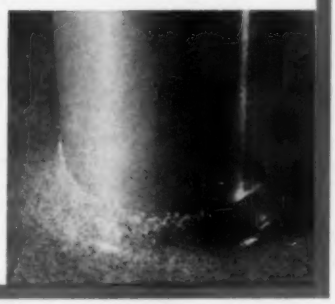
How "Microballoon" Spheres Cut Evaporation

Laboratory beaker shows how "Microballoon" spheres form a blanket on oil surface, sealing it effectively against evaporation loss.



Convenient method of installation is to pump the "Microballoon" spheres into tank along with oil, using an aspirator similar to those for foam fire-fighting systems.

Blanket of "Microballoon" spheres covers surface completely around walls and internal supports in the tank as the oil level rises and falls.



Evaporation loss cut 79% for three years

WITH "MICROBALLOON"* SPHERES

Here's a successful case history on evaporation control that has saved many thousands of dollars over three years. The annual evaporation loss was sharply cut from 13,700 barrels to only 2,700 barrels for five cone-roofed tanks. And this money-saving installation paid for itself in a matter of months!

Approximately 22,000 pounds of "Microballoon" spheres were installed in five cone-roofed tanks at the Salem, Illinois, station of the Sohio Pipeline Company. After three years, this same installation is still cutting evaporation loss *without additional investment!*

Experience has shown that "Microballoon" spheres are non-abrading, won't harm tanks, pipes, or pumping equipment. For further information, write Bakelite Company, Dept. AY-128.

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For evaporation control...

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BAKELITE COMPANY, *Division of Union Carbide Corporation,* 30 East 42nd Street, New York 17, N. Y.

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formed in tanks that are being filled with hydrocarbons, and some explosions have been attributed to discharge of the static electricity produced in these dispersions.

A preliminary investigation was made of the behavior of JP-4 fuel when dispersed in air. A domestic-type heating-oil unit was used to inject JP-4 into the side of the 55-gal. explosion drum at a flow rate of 1,200 ml. per hour. No explosion occurred. However, the radio static-discharge detector indicated that low-order electric discharges were occurring in the drum at intervals of several seconds.

It was subsequently found that ignition did not always take place when the JP-4 mist was sparked with the use of an automotive spark plug and a spark coil. Widening the spark gap so that the spark would "see" a larger sample of the mist made ignition more certain.

It is concluded that mists and sprays of JP-4 in air could produce dangerous levels of static electricity under certain conditions, and additional work is planned along this line. This work will include a study of the effect of particle size and air-fuel ratio on static production and ignition.

E. Antistatic Additives

When the electrical conductivity of hydrocarbons approaches the level of 1×10^{-11} ohm^{-1}cm^{-1}, the rate of production of static electricity generally drops off rapidly. It has been found that the electrical conductivity of hydrocarbon fuels can be conveniently increased to the range of 3×10^{-12} ohm^{-1}cm^{-1} to 1×10^{-11} ohm^{-1}cm^{-1} by the use of low concentrations (0.005 per cent) of additives and, in the conventional laboratory tests, static production reduced to a low level.

On a theoretical basis, the use of additives which would increase electrical conductivity should be helpful in reducing electrostatic hazards. It must be recognized, however, that there are certain limitations involved in this method. For example, their use would probably be limited to situations where the charge is developed in the liquid hydrocarbon.

Additives would not be expected to prevent static production in mists and fogs of hydrocarbons in all cases. Furthermore, under some laboratory conditions, high concentrations of additives (>0.05 per cent) are required to minimize static production. For example, in laboratory tests where the equipment has become activated through exposure to highly active fuels, low concentrations of additives are almost completely ineffective.

Similarly, when a very active fuel is continuously circulated over a charge-separating surface such as tank scale, low concentrations of additives will not prevent the formation of discharges within the liquid hydrocarbon. At the present time, it is not known whether field equipment can become as highly activated as has been found for laboratory equipment.

Until this has been established, it will not be possible to decide on the amount of antistatic additives which will be required to provide adequate protection under service conditions.

Quaternary ammonium and phosphonium salts of organic and inorganic acids; quaternary sulfonium compounds; and ammonium, alkali, and alkaline earth salts of organic acids markedly increase hydrocarbon conductivity.

All of the additives studied so far are polar conpounds which are surface active and promote the formation of emulsions when the blends are mixed with water. Thus they fail to meet the water-tolerance specification of jet fuels and, in addition, are rather easily extracted on contact of the fuel with water. The search for less sensitive additives is being continued.

1. Method of selecting additives . . . Antistatic additives may be screened by measuring the electrical conductivity of hydrocarbon blends. The materials which increase electrical conductivity to approximately 3×10^{-12} ohm^{-1}cm^{-1} or higher are then selected for further evaluation.

It appears that the ability of some additives to increase the electrical conductivity of hydrocarbon fuels and to prevent static is related both to the polarity of the static-producing contaminants and to the polarity that the additive imparts to these suspended impurities.

This has been substantiated by electrophoresis experiments which have shown that additives are adsorbed on sludge and can modify both the magnitude and the polarity of the charge on the sludge, depending on the additive type used and the original polarity of the fuel (as indicated by laboratory pumping tests). The over-all relationship between fuel polarity and additive polarity is shown in Table 22.

Concentration studies show that, in a negative fuel, approximately eight times as much additive A as additive B is required to bring the conductivity to a level of 3×10^{-12} ohm^{-1}cm^{-1}. In a positive fuel, however, additive A is roughly five times more effective than additive B. A combination of the two additives is effective in both types of fuels. These data are summarized in Table 23.

TABLE 22—RELATIONSHIP BETWEEN FUEL POLARITY AND ADDITIVE POLARITY

Additive	Effective in Jet Fuel Type*		Charge Induced on Contaminants by Additive †
	Negative	Positive	
A	No	Yes	Negative
B	Yes	No	Positive

*On the basis of electrical conductivity and laboratory pumping tests.

†As indicated by electrophoresis measurements.

TABLE 23—CONDUCTIVITY OF ADDITIVE BLENDS

Concentration (Per Cent by weight)		Specific Conductivity $\times10^{12}$ (Ohm^{-1}Cm^{-1})	
Additive A	Additive B	Negative Fuel	Positive Fuel
0.0025	...	0.2	...
0.005	...	1.6	6.0
0.04	...	3.7	...
...	0.0025	2.5	...
...	0.005	4.5	1.3
0.0025	0.0025	3.0	4.0

The results given in Table 23 indicate that a single additive at 0.005 per cent concentration would not be sufficient to eliminate or reduce the electrostatic hazard with all types of fuels encountered in the field. For adequate protection a combination additive, of mixed polarity, is preferred.

Since antistatic additives contain some colloidal materials, and since they increase the electrical conductivity of fuels to which they are added, it would be expected that if the additive were present in a concentration somewhat less than that required to produce an electrical conductivity 3×10^{-12} ohm^{-1}cm^{-1}, the antistatic additive might behave as a pro-static agent.

Actually, in commercial fuels, this has not been found to be the case. That is, all concentrations studied (up to 0.04 per cent active ingredient), the additive combinations which are under investigation behave as antistatic agents. In very pure fuels, such as isooctane or clay-treated jet kerosine, the antistatic additives have a slightly harmful effect.

The action of the antistatic additives appears to be opposed to that of prostatic materials, such as asphalt. It will be recalled that the addition of small amounts of asphalt markedly increased the static-producing activity of commercial fuels but had little effect on pure fuels.

The evaluation of antistatic addi-

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IS A METAL DEACTIVATOR WORTH WHILE?

TENAMENE 60 pays off in case after case

Eastman Copper Chelating Additive

- **Inhibits gum formation in motor gasoline**
- **Stops color degradation in kerosene**
- **Reduces fuel oil clogging**
- **Improves stability of jet fuel**

Even trace amounts of copper can be extremely harmful to most petroleum products.

Eastman's metal deactivator, Tenamene 60, used in amounts from 1 to 3 pounds per 1,000 barrels, protects most petroleum products in storage and during use from the detrimental effects of copper-catalyzed oxidation reactions. A chelating agent, Tenamene 60 ties up the copper to form a non-reactive, non-catalytic compound.

Gasoline

Copper has a powerful pro-oxidant effect on gasoline and catalyzes normal gum-forming reactions. Its presence requires an excessive amount of antioxidant to obtain a satisfactory induction period. A more effective and a more economical method is to use Tenamene 60 in conjunction with a normal amount of antioxidant.

Refiners need Tenamene 60 for adequate protection of motor gasoline. The increased use of catalytically cracked stocks makes storage a particularly troublesome problem inasmuch as these stocks are more susceptible to oxidation and, hence, to the catalytic action of copper. The test data shown in the accompanying table below demonstrate the beneficial results obtained from the use of Tenamene 60 in a blended gasoline containing approximately 45% catalytically and thermally cracked stocks.

Effectiveness of Tenamene 60 in Protecting Gasoline

Sample	Induction Period	Peroxide Number	ASTM Gum	Copper Dish Gum
Unprotected Gasoline				
Initial	330	0.1	3.1	4.0
After 20 weeks at 110°F	—	30 *	116 *	575 *
Gasoline protected with Tenamene 60*				
Initial	780	0.1	3.1	4.0
After 20 weeks at 110°F	—	1.0	4.6	8.0

*2 lbs. per 1,000 bbls.

Alchemist's symbol for copper

Kerosene

When kerosene is copper-sweetened or contains dissolved copper from other sources, color degradation frequently occurs due to the catalytic action of the copper. The Saybolt color value of a typical untreated kerosene containing copper, heated for 24 hours at 212°F, changed from 25 to 14. Protected by just 2 pounds of Tenamene 60/1,000 barrels, the Saybolt color value of this same kerosene changed hardly at all...from 25 to 24.

Diesel and Home Heating Fuel

Two problems exist in the storage and use of diesel and home heating fuels. One is formation of copper-mercaptide, a waxy, jelly-like substance, on brass screens, nozzles and filters. The second is formation of an organic gum-like material that binds sludge. Tenamene 60 helps solve both problems by retarding the catalytic action of copper promoting these reactions.

Jet Fuels

Test results using a CFR fuel Coker* instrument show the addition of a small amount of Tenamene 60 increases significantly the stability of most jet fuels at high temperatures when these fuels contain copper. Tenamene 60 is approved and widely accepted for use in this type of fuel.

Tenamene 60 also should be evaluated as a means to improve the stability and performance of *turbine oils, bearing greases, hydraulic fluids* and *lubricants* subject to copper-catalyzed oxidation.

In case after case, use of Tenamene 60 insures optimum performance of gasoline, fuel oil, kerosene, jet fuels ...especially following prolonged storage.

Investigate the protection Tenamene 60 can bring your refinery products. For more information, write to EASTMAN CHEMICAL PRODUCTS, INC., a subsidiary of EASTMAN KODAK COMPANY, Kingsport, Tennessee.

*The CFR fuel Coker instrument (ERDCO rig) measures the rate at which pressure develops as heated fuel is circulated through a filter. Test results are relative and are given as "fuel goodness ratings."

Tenamene 60

EASTMAN METAL DEACTIVATOR

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Mass.; Cincinnati; Cleveland; Chicago; St. Louis; Houston. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle; Denver; Spokane; Phoenix.

tives is now being carried out in large-size experimental equipment which is patterned after typical refinery installations. Until it has been possible to repeatedly produce static-electricity explosions in this equipment, and to demonstrate that antistatic additives will eliminate them, it cannot be decided whether antistatic additives will provide a satisfactory solution to this problem.

2. Mechanism of antistatic additive action . . . As discussed previously, antistatic additives appear to function mainly by increasing electrical conductivity to the level at which the rate of charge dissipation or recombination dominates the rate of charge separation.

The increase in conductivity obtained with the additives appears to be much greater than would be expected from electrostatic dissociation of the additives in solution. The electrophoresis measurements suggest that the additives are adsorbed on the colloidal particles and that "colloid ionization" may be involved.

During the course of some of the laboratory pumping tests, a reversal of polarity is frequently noted. This has been taken to mean that the hydrocarbon contains a mixture of compounds, some of which tend to leave a positive charge at the surface and others a negative charge.

At any one time, the polarity of the type of compound present in the higher concentration will determine the polarity left on the surface. Upon continued recirculation, the more strongly adsorbed ion may become depleted or chemically altered so that the ion of opposite sign will then be adsorbed. The presence of mixtures of strongly adsorbed ions of opposing polarity is in agreement with the results of evaluation of both single additives and combinations of additives.

The more effective additives have high surface activity and are strongly retained by charge-separating surfaces. This was demonstrated in a laboratory pumping test in which the test equipment, after exposure to the additive-containing fuel, remained inactive to several fresh charges of additive-free fuel.

Since it appears that the additive may create a region of high electrical conductivity in the vicinity of the charge-separating surface, experiments are now being carried out to study this effect further.

Light-scattering measurements indicate that, upon the introduction of the antistatic additives, there is no appreciable change in the number and size of suspended particles. It thus appears that the mechanism of antistatic action does not involve peptization or agglomeration of colloids.

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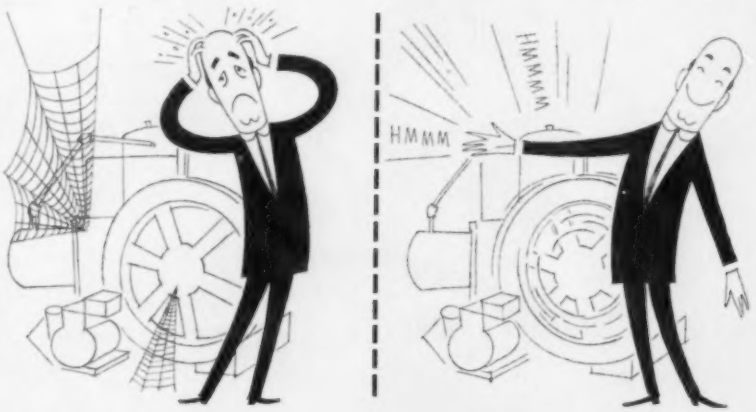
2. J. D. Piper, "Liquid Dielectrics," Dielectric Materials and Applications, edited by A. R. Von Hippel, 156, Massachusetts Inst. of Technology Press, Cambridge, Mass. (1954).

BOOK

THE INSTITUTE OF PETROLEUM DRILLING AND PRODUCTION SAFETY CODE. Published by the Institute of Petroleum, Manson House, 26 Portland Place, London, W.1, England. This code is issued as a guide to all concerned in the operations of wells and associated equipment in modern producing oil fields. It contains information on: (1) definitions, (2) the well site, site development, buildings, (3) explosives, (4) fire-fighting services, (5) drilling rigs, and other phases of the industry.



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HE DID

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For best results, fracturing fluid must enter the pay zone with enough velocity to carry its cargo of sand deep into the formation. Often, when the sand-laden fluid enters a "mudded off" formation, fluid velocity is decreased and the sand is "screened out" in the well bore. The result may be a poor fracturing job.

This situation can be avoided by using Mud Acid as a spearhead for fracturing. Mud Acid, a combination of hydrochloric and hydrofluoric acids, has the ability to dissolve or disintegrate drilling mud materials, such as bentonite. This permits fracturing fluids to enter the formation at reduced pressures and higher velocities. It also provides better distribution of the sand and increased permeability in the critical area surrounding the well bore.

Versatile Mud Acid is also used to open mud-fouled screens and liners and to free stuck drill pipe. It is an effective spearhead to clean up the well ahead of squeeze cementing operations.

For more information on the many uses of Mud Acid, call any of the 165 Dowell offices in the United States and Canada; in Venezuela contact United Oilwell Service. Or write to Dowell Incorporated, Tulsa 1, Oklahoma.

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Reducing Static Electricity inside storage tanks by use of radioactive material

Here is a progress report on laboratory and full-scale experiments using strontium-90-yttrium-90 as the radioactive source

By J. J. Conradi, J. R. Miller, and J. J. Skelly

THE RADIOACTIVE source functions by ionizing the vapor space and thereby producing a conductive path through which the charge on the hydrocarbon surface can be dissipated.

Laboratory experiments show:

- Useful discharge currents can be realized from a nominal 0.1-curie strontium-90-yttrium-90 beta source. If surface potentials of about 1,000 volts are considered essentially safe, continuous charging currents as high as 0.1 μa. can be handled safely in small-tank applications.

Full-scale tank experiments indicate:

- The source produces a real lowering of the field when the conductivity of the hydrocarbon is 5×10^{-15} ohm^{-1} $cm.^{-1}$ When the conductivity is increased to 1.2×10^{-13} ohm^{-1} $cm.^{-1}$, no reduction of the field by the source occurs: rather, the equilibrium indicated field increases.

This increase has been interpreted as the direct effect of the source on the field-meter indication, independent of the surface voltage.

The highly attractive and simple direct method of measuring the voltage of the hydrocarbon surface has been shown to yield unreliable results.

Authors are with Shell Oil Co., Wood River, Ill. Paper presented at A.P.I. annual meeting, Chicago.

The radioactive source used in these studies is a nominal 0.1-curie hermetically sealed source. An exploded perspective of the source as received is shown in Fig. 1. The isotopes involved are separated fission products, strontium-90 in equilibrium with its decay products yttrium-90.

Laboratory experiments . . . The final object of the investigations reported in this paper is to limit the maximum voltage on the surface of the hydrocarbon during filling and mixing operations to values which are considered safe. Such a safe voltage would require, in the limiting case of equilibrium conditions, that charge be removed from the surface by the ionized atmosphere at the same rate that it is introduced by the filling or mixing process.

It is of interest, therefore, to measure the rate at which charge can be removed from a charged object through the ionized atmosphere produced by the nominal 0.1-curie source.

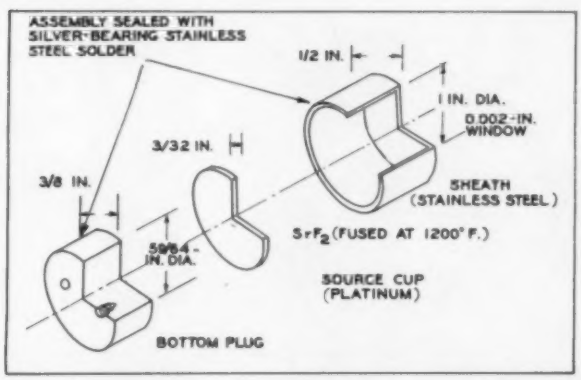
The rate at which an object can be discharged by this method is a complicated function of the distance to the source and the way in which the field strength varies in the space around the object. However, some idea of the magnitude of the discharge currents can be derived from the simple experiment of measuring the rate of discharge of an insulated metal plate.

From the rate of discharge and the capacitance of the voltage-measuring device, the discharge current may be calculated. These results are given in Table 1 and are intended only to show the current as a function of the distance of the plate from the source. In Fig. 2 are plotted the count rate and the discharge current for the 14.5-sq.-ft. plate as a function of this distance. It is seen that the discharge current does not rise as rapidly as the count rate with a decrease in distance.

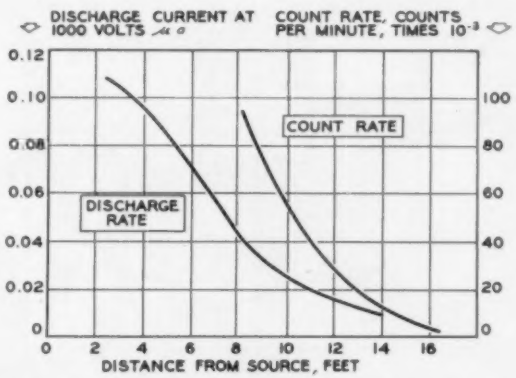
This is due to the fact that the total ionization between the plate and the source is not proportional to the number of particles but to the product of the number of particles and the path length of the particle. This effect is important when considering the case where the tank is filled to the top

TABLE 1—DISCHARGE CURRENTS FOR VARIOUS DISTANCES FROM THE SOURCE

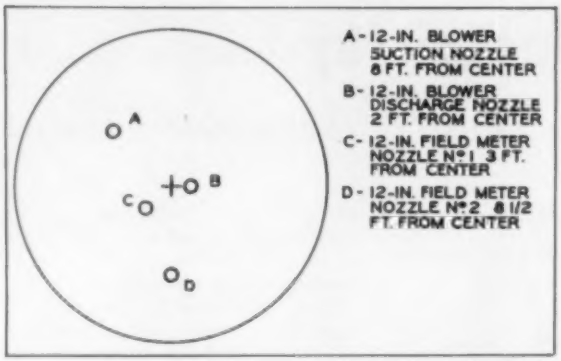
Plate area (sq. ft.)	Distance of plate from source (ft.)	Voltage on plate (volts)	Discharge current (μa.)
0.44	15	900	0.0007
0.44	12	900	0.0016
0.44	9	900	0.004
0.44	6	900	0.008
0.44	3	900	0.02
14.5	15	900	0.0076
14.5	12	900	0.015
14.5	9	900	0.031
14.5	6	900	0.069
14.5	3	900	0.104



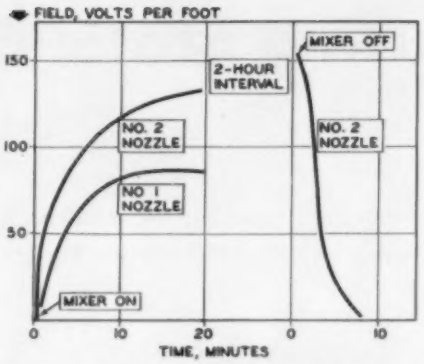
RADIOACTIVE SOURCE used in the studies described in this article, as shown in exploded perspective view. Fig. 1.



COUNT RATE and discharge current for 14.5 sq. ft. plate used in laboratory experiments. Fig. 2.


A - 12-IN. BLOWER SUCTION NOZZLE 8 FT. FROM CENTER
B - 12-IN. BLOWER DISCHARGE NOZZLE 2 FT. FROM CENTER
C - 12-IN. FIELD METER NOZZLE N°1 3 FT. FROM CENTER
D - 12-IN. FIELD METER NOZZLE N°2 8 1/2 FT. FROM CENTER
A
B
C
D

BLOWER-ASSEMBLY and various nozzle positions used in the full-scale tank tests. Fig. 3.



TYPICAL FIELD BUILDUP CURVES for two positions of field meter and typical field decay curve. Fig. 4.

and the residual vapor volume is reduced to the vanishing point.

Full-Scale Tank Equipment

A trial experiment was performed in a refinery cone-roofed tank to determine if the radioactive source would have an appreciable effect on the potential of the liquid surface in a vessel this large. The tank was 30 ft. in diameter and 20 ft. high and contained a vertical center post to support the roof.

The tank was filled to a depth of 11 ft. with mineral spirits having a conductivity of 5×10^{-15} ohm^{-1} cm.$^{-1}$ A propeller mixer driven by a 7.5-hp. motor was used to produce a charge in the liquid. In addition, the tank was fitted with 60 ft. of 4-in. pipe in the form of a recirculating line, with the intake on the surface and the discharge 2 ft. above the bottom.

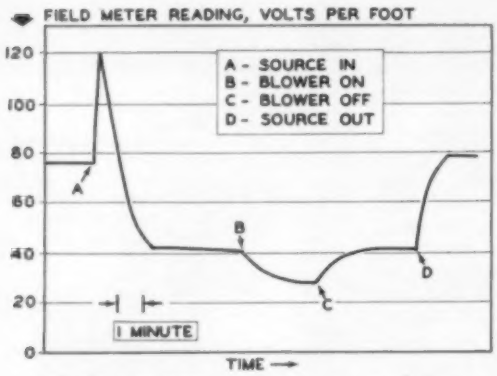
A steam-driven pump was included in the recirculating line. This recirculating attachment was intended to give a measure of the voltage on the surface of the hydrocarbon as a function of the recirculation rate. In practice it proved incapable of producing voltages high enough to be of much use.

Therefore, the mixer alone was used to develop the charge in the hydrocarbon for the purposes of these experiments. Extra nozzles were installed in the roof for the attachment of a 1,200-cu.-ft. per minute recirculating blower which discharged straight down at a point 2 ft. off the center.

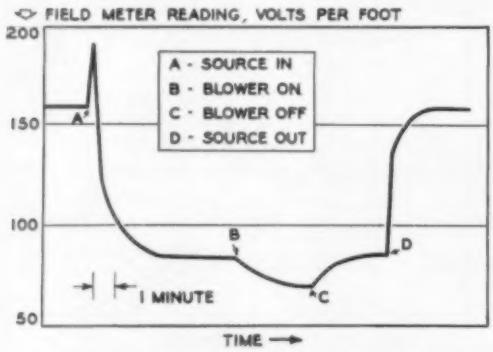
The positions of the various nozzles and the blower assembly are shown in Fig. 3.

In these experiments it was intended to measure both the electric field in the vapor space at the roof and the voltage on the surface of the hydrocarbon. The electric fields were measured with a device called a field meter, which is capable of reliably measuring static electric fields as small as 6 volts per foot and as large as 800 volts per foot.

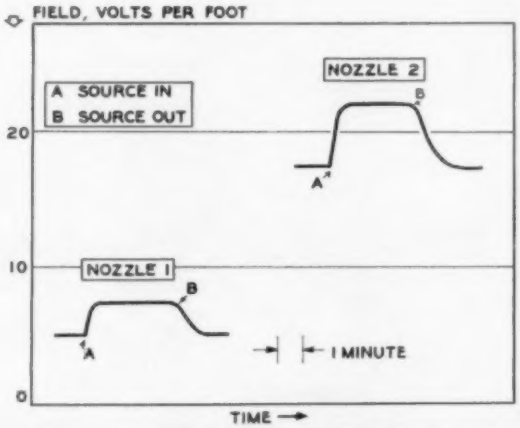
From a single measurement of the electric field in the tank, it is possible to calculate the corresponding voltage on the surface of the hydro-



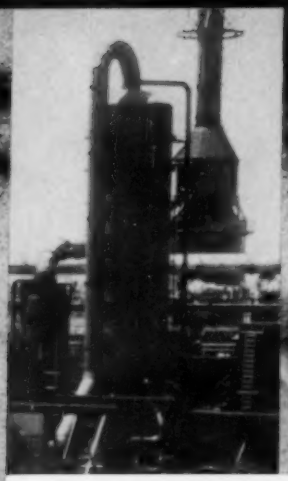
EFFECTS ON FIELD at the No. 1 nozzle. Fig. 5.



EFFECTS ON FIELD at the No. 2 nozzle. Fig. 6.



EFFECT ON INDICATED FIELD when the hydrocarbon has maximum allowable conductivity. Fig. 7.



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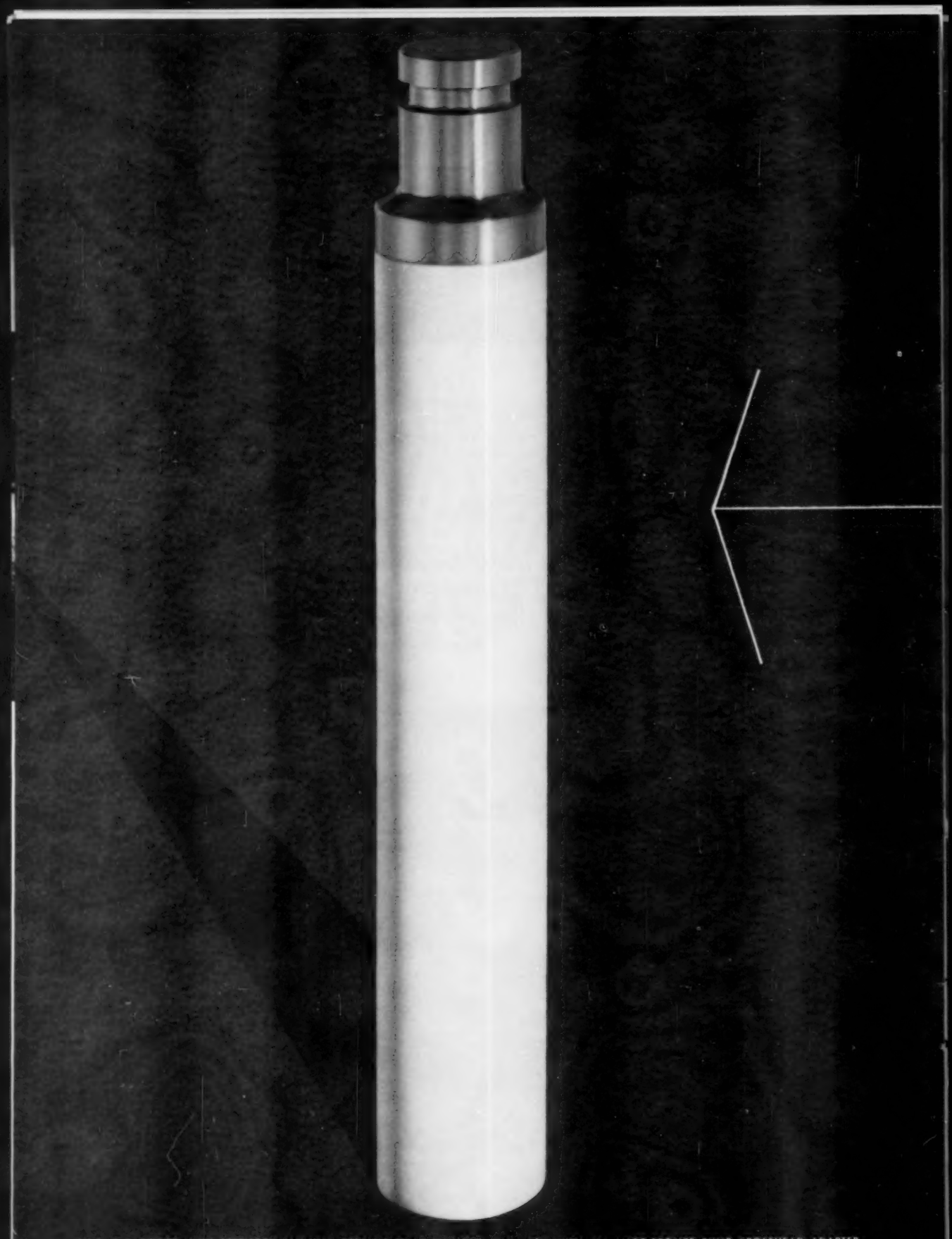

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Hardness	Moh's Scale	9
Maximum Working Temperature	°F	2550
Closest Machined Tolerances	inches	0.000020

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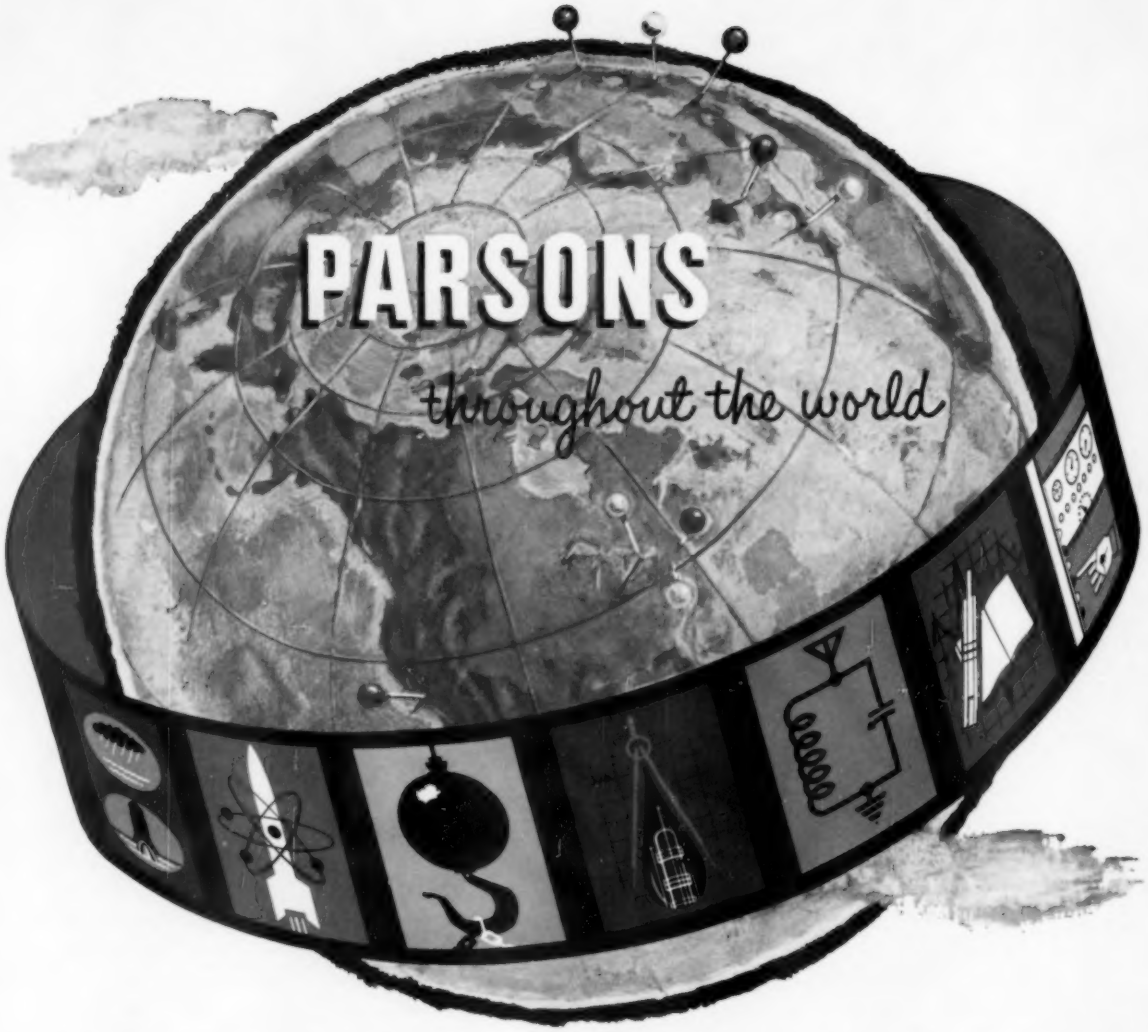

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carbon if the liquid is assumed to have an equipotential surface. It is easier, however, and sufficiently accurate for our purpose, to measure the field distribution in a three-dimensional scale model of the tank.

From the measurements in the scale model, it is found that the product of the measured field and the roof to liquid surface distance must be multiplied by 1.5 to give the voltage on the liquid surface.

These calculated voltages were to be compared with voltages measured directly. The direct measurements were made with a float covered with metal foil which rested on the surface of the liquid. The float was connected by a well-insulated wire to an electrostatic voltmeter.

Unfortunately, the direct measurement of the hydrocarbon voltage proved, in the final stages of the experiments, to be unreliable. Therefore, no measured voltages are included in the experimental results. The direct method will be taken up in more detail in the discussion which follows this section of the paper. Typical field buildup curves for the two positions of the field meter and a typical field decay curve are shown in Fig. 4.

In Figs. 5 and 6 are represented the effects on the field, at the No. 1 and No. 2 nozzles, respectively, of the introduction of the source. The source is introduced in the exhaust line of the vapor recirculator and suspended 1 ft. below the roof for this and all other experiments. Also shown is the effect of turning on the blower.

To explain the sudden rise of the indicated field upon the introduction of the source, appoximately 10 p.p.m. of the C_{14}-C_{16} alkenyl succinic acid was added to the mineral spirits to raise its conductivity to 1.2×10^{-13} ohm^{-1} $cm.^{-1}$ For a fluid with this conductivity, it is assumed that the source has very little effect on the equilibrium surface voltage since conductivity of the liquid is somewhat higher than that of the ionized vapor.

The minimum usable field sets the upper limit on the conductivity of the liquid. The effect on the indicated field of the introduction of the source when the hydrocarbon has this larger conductivity is shown in Fig. 7. Here it is seen that approximately the same relative rise in the indicated field occurs upon introduction of the source as was observed in Figs. 5 and 6, except that the indicated field remains at the higher value and does not drop as before.

We feel that these observations are explained by the effect of two separate factors. One is the increase in the dielectric constant of the vapor space due to ion formation. Since the field meter actually measures the dielectric displacement, the result of an increase in the dielectric constant of the vapor at the field meter is a proportional increase in the indicated field.

The other factor is the nonuniform distribution of the ion density, which distorts the electric field with an influence on the field meter which depends upon the ion cloud position. These two factors operate independently in their effect on the field meter. The combined effect is presumed to be approximately proportional to the average field.

The ratio of the indicated maximum field after introduction of the source to that before introduction of the source (for any one position of field measurement) should then be nearly the same regardless of the hydrocarbon conductivity. The foregoing ratios, and the appropriate values of the field taken from Figs. 5, 6, and 7, are tabulated in Table 2. The agreement is considered reasonable.

TABLE 2—EFFECT OF SOURCE ON ELECTROSTATIC FIELD

	Low-conductivity hydrocarbon—field measurement			
Nozzle No.—	1	2	1	2
Before introduction of source	76	160	5	17.5
After introduction of source	120	190	7.2	22
Ratio of field after to field before introduction of source	1.6	1.2	1.4	1.3

It is concluded, then, that the equilibrium fields shown in Figs. 5 and 6 after the introduction of the source should be divided by the appropriate ratio of Table 2 to give fields corrected for the combined effect of increased dielectric constant and distortion of the field. The effect of the source then is to reduce the field in the full-scale experiments to approximately one-half at the No. 2 nozzle and one-third at the No. 1 nozzle.

The effect of the blower on the field is seen to be relatively small. It did not prove practical to determine the effect of the blower with the high-conductivity mineral spirits since the rather large and rapid fluctuations in indicated field which occur during its operation obscured the small changes in field.

Discussion

Mention was made earlier of our intention to compare hydrocarbon voltages calculated from field-meter readings with voltages measured directly with the float and voltmeter. This did not prove possible in practice because, with the original mineral spirits, equilibrium was not attained even after periods as long as an hour. The nonequilibrium, still-rising voltages that were recorded were of the correct sign as ascertained from the field-meter response and usually within a factor of two of the calculated value.

The material of the float had no apparent influence on these observations. Iron, aluminum, copper, and tin plate exhibited the same behavior. However, when direct measurement of the voltage of the mineral spirits to which C_{14}-C_{16} alkenyl succinic acid had been added was attempted, it was found that a brass float gave a voltage high by a factor of four and of the wrong sign.

When the float material was changed to iron, the voltage was high, but within a factor of two of the calculated value and of the correct sign. The float-voltmeter method is, therefore, not a generally valid method. This was an unexpected result since it was felt that if the probe were in error, it would be on the low side for an iron float.

One may argue that if shearing the hydrocarbon-iron interface at the propeller mixer leaves the hydrocarbon charged positively, the shearing of the interface at the iron float in the moving liquid would tend to deposit a positive charge on the probe and thereby reduce its indication of the negative charge in the hydrocarbon. The behavior of the brass float is even more unexpected. The actual potential difference between the float and the hydrocarbon was approximately 1,200 volts.

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Shell research successful . . .

Antistatic Doping Safeguards Shipments of Petroleum Products

By A. Klinkenberg

STRONG electric fields, ranging up to 600 kv. per meter have been measured in tanks. If the electric conductivity of the product was raised, the field strength was always ultimately reduced and became very small. A conductivity of 10^{-11} ohm^{-1} cm.$^{-1}$ =1,000 picomhos (micro-micromhos) per meter was found to safeguard even the cases of strongest charging and still allow a comfortable safety margin.

Research has been directed toward the development of suitable additives which would raise the conductivity of petroleum products to a safe level. It has been found that certain combinations of additives are far more active than the individual components, which makes it possible to keep the concentration of additive very low.

A favorable combination has been found by Shell Oil Co. and is at present being used to safeguard shipments of certain products. Only very small concentrations of this additive combination are required, viz., 0.7 lb. of a concentrated solution per 1,000 bbl. of product.

By antistatic doping of a product not only is the explosion hazard eliminated, but pumping rates can be increased above what was hitherto considered a safe maximum.

In view of the importance of this subject to the industry as a whole, and the current widespread interest, N. V. De Bataafsche Petroleum Maatschappij has decided to issue its report in book form.[2] Many people have contributed to the work presented in this paper and still more to the aforementioned book. It is impossible to name them separately, but their share in the common effort is gratefully acknowledged.

Author is with N. V. De Bataafsche Petroleum Maatschappij. Paper presented at annual A.P.I. meeting, Chicago, under the original title, "Laboratory and Plant-Scale Experiments on the Generation and Prevention of Static Electricity."

Accidents Ascribed to Static Electricity

A study of the reports on more than 50 accidents, ascribed to static electricity, which have occurred in the past 20 years has shown that they could be placed in the following categories:

1. Charging of an insulated metal container by filling with a charged liquid: This used to be a frequent cause of accidents. However, such accidents have become rare; apparently the necessity for grounding the container is well understood nowadays.

2. Charging caused by particles in a flow of gas: On record are 6 accidents and 12 casual observations of sparks.

3. Explosions inside grounded containers: This is by far the largest group; 46 explosions are on record.

Charging of an insulated metal container . . . Many accidents used to occur when nongrounded tank trucks were being filled with a volatile product. But as the necessity for grounding tank trucks, aircraft, etc., has become generally known, case histories of such accidents have not been collected for this survey.

In this case the danger results from a high potential of the container itself, the charge being introduced from the outside, e.g., by filling the container with a charged liquid entering through a nonconducting hose or as a free jet. In settling processes, although there is a separation of charges, there is never a net free charge and, therefore, the tank wall will not become charged by induction.

The following reasoning shows the degree of insulation required in order that the container may be described as "insulated" for the purposes of this section. As the charging currents observed in the petroleum industry are usually below 1μa, a resistance to ground of less than 300 megohms will prevent the potential of the insulated tank from reaching a value of 300 volts, which is the minimum value at which sparking can occur. All stationary tanks are much better grounded.

Charging by particles in a flow of gas . . . Details of 6 accidents and 12 chance observations in refineries, attributed to charging by a flow of contaminated gas, have been collected.

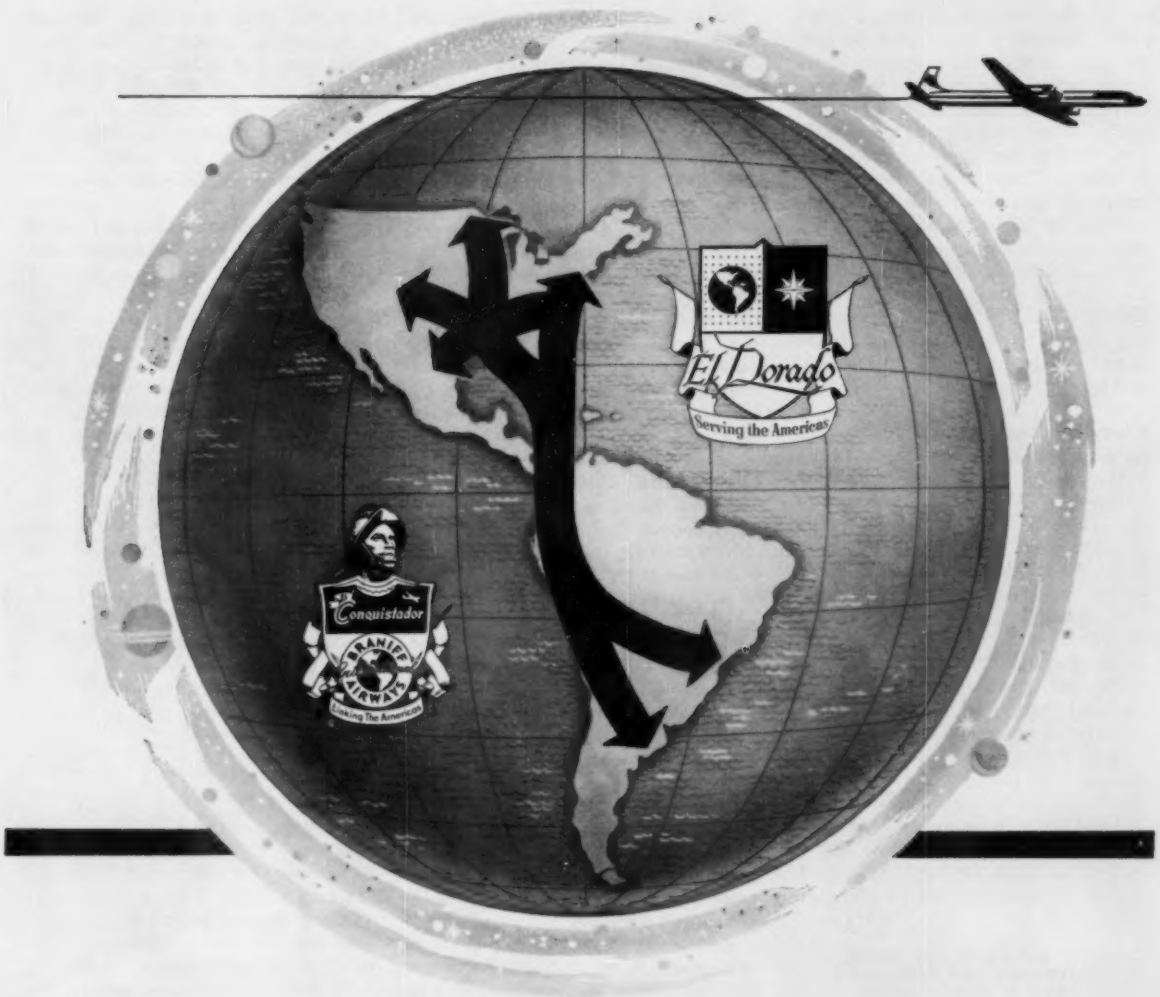
A gas uncontaminated by a mist or by dust is electrically inactive. With a gas containing particles, the separation of charges must be visualized as taking place in the liquid film which wets the conduit nozzle (in gas plus mist), or as being caused by frictional contact (in gas plus dust).

Wet steam, evaporating carbon dioxide (CO_2), and evaporating propane have been involved. In the cases examined, the phenomenon is, of course, not limited to these gases; it is a well-known fact that sandstorms, hail, snowstorms, sandblasting, and pneumatic transport of solids have an electric charging effect.

. . . Flow of wet steam. Steaming out has caused several accidents Steam leaks have often been reported as being the cause of sparking between the sheets of metal which cover insulated lines. In one case, oil soaked lagging caught fire. Persons near steam jets have also found that they were being charged, a typical example being fitters attending to steam leaks.

. . . Flow of carbon dioxide. Rapidly evaporating CO_2 forms a mist containing solid CO_2. A tank explosion with very grave consequences resulted where a CO_2 protection system was used in a tank containing jet fuel.[4]

. . . Flow of propane. A serious fire occurred in a propane bottling installation. It was thought that gas pockets had been cleared from the filling line by allowing some liquid propane to



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escape, thus charging a nongrounded object. Sampling liquid propane into thermos flasks has sometimes resulted in fires. Inserting a grounded wire into the flask prior to filling proved to be an adequate precaution.

In most of the foregoing cases there is evidence that there was a nongrounded conductor to which the charges could be conveyed. Such a situation is generally recognized as being dangerous. The insulated object can also be the gas nozzle. In this case the electrification is caused by the charges left behind, which are opposite in sign to those carried by the particles.

Charging inside grounded containers through flow of liquids . . . This group comprises the largest category of tank explosions. The aspects common to the majority of these explosions are the following:

1. The explosions occurred during filling or stirring, or shortly afterward.

2. The circumstances were such that the presence of systems of two or three fluid phases—dispersions of water, or other liquids, and/or air in hydrocarbons—was either known or strongly suspected.

The operations which are considered to have led to the explosions (see Table 1) can be described as follows:

(a) Mixing water or air into oil by introducing one of the phases at a incorrect level in the tank, i.e., in the region ocupied by one of the other two; or

TABLE 1—SURVEY OF TANK EXPLOSIONS ASCRIBED TO STATIC ELECTRICITY

	No. of explosions
1. Incorrect level of inflow:	
(a) Splash filling of oil	3
(b) Splash filling of water or chemical solutions in a tank already containing oil	4
(c) Splash filling of spent sulfuric acid in a storage tank containing an accumulation of separated oil	4
2. Simultaneous introduction of two phases:	
(d) Mixed flow (oil - aqueous liquid or air-oil) in pipeline to storage tank	18
(e) Settling in tanks	2
3. Emulsification of tank contents:	
(f) Stirring up of water bottoms. (Several accidents of this group occurred during blending, e.g.: introducing a gasoline stream just above a water interface; introducing butane through a water drawoff line; mechanical mixing in tanks containing water bottoms)	7
(g) Agitating during treating operations	8

(b) Simultaneously introducing two phases; or

(c) Emulsifying materials already present in the tank, either by disturbance due to incoming flow or by agitating or stirring devices.

These three types of causes of tank explosions are exemplified by the grouping of 46 explosions given in Table 1.

For the production of a spark within a tank there are, in principle, two possibilities, as given in the following paragraphs:

1. The tank contains an insulated conducting object at a suitable distance from grounded surroundings: A spark between two conductors can easily be of a sufficient intensity to ignite an explosive mixture. The presence of insulated metal objects in a tank is, therefore, found to be associated with grave danger.

It is unlikely that there could have been insulated parts of tank internals or tank structures in all the cases investigated, although this may have happened occasionally—for instance, during gaging by means of a tape.

2. All parts of the tank are grounded: In this case, the spark must have occurred between charged liquid and grounded surroundings.

As the resistance from a storage tank to ground is already far below the 300 megohms mentioned earlier, it is evident that extra connections to ground will be of no avail. For the same reason the humidity of the outside atmosphere has no influence.

As the occurrence of two-phase or three-phase systems proves to be essential, and since materials already present in a tank can produce accidents due to emulsification, it is suggested that the settling mechanism may play an important role in the electrification in tanks.

In most of the aforementioned explosions, the equilibrium vapor composition of the product handled was within the explosion limits at the prevailing temperature.

There were, however, several cases where the product was below its flash point, i.e., the equilibrium vapor was too lean. In these cases there were indications that there had been contamination by gasoline (successive pumping of gasoline, water, and kerosine, with the chance of contamination at the branching of the line to the gasoline and kerosine storage tanks), or that there could have been mist formation above the liquid in the tank (e.g., due to air in filling lines or to splash filling).

Comparison with A.P.I. Survey

In a report of the A.P.I. Committee on Static and Stray Currents[5] a survey was given of accidents believed to have been caused by static electricity (see Table 2).

The precise circumstances of these accidents are not available. However, Tables 1 and 2 show that it is generally agreed that the group of two or three-phase systems within grounded containers (Groups 1, 2, and perhaps 4 in Table 2; 46 explosions in Table 1) is by far the most important one, and that steaming out comes next.

Most observations in Table 1 were made after 1940, the date of issue of the A.P.I. report.

Liquids of low conductivity can be conveniently characterized by the half-value time of decay of charges, i.e., the time required for charges to decrease to one-half of their original value after their generation.

For hydrocarbons (dielectric constant = 2), half-value time and electric conductivity are related in the manner indicated in Table 3.

Table 3 covers the region of principal interest for volatile petroleum products, and it is seen that the half-value time may be many seconds.

For aqueous solutions, on the other hand, the half-value time is about a microsecond or less.

Conductivity

It may suffice to state that the conductivity of white products is generally between 0.1 and 10 picomhos per meter (10^{-15} to 10^{-13} ohm^{-1} cm.$^{-1}$).

Crude oils have conductivities of 1,000 to 100,000 picomhos per meter. The conductivity is linked with the presence of asphaltenes. Crude oils have such a high conductivity that they cannot accumulate static electricity and therefore, in this respect, are safe to handle. While the crude oil or its asphaltenes would be a very

TABLE 2—A.P.I. SURVEY OF EXPLOSIONS AND FIRES ASCRIBED TO STATIC ELECTRICITY

	No. of cases	Per cent of total
1. Agitation, either intentional or accidental	63	57
2. Improper filling	10	16
3. Steaming	6	10
4. High-velocity filling	4	6
5. Static charges from operator	4	6
6. Powder blown by air	2	3
7. Lightning	1	2
Total	63	100

TABLE 3—RELATION BETWEEN HALF-VALUE TIME AND CONDUCTIVITY

Half-value time (sec.)	Conductivity ohm^{-1} m.$^{-1}$	Conductivity ohm^{-1} cm.$^{-1}$	Conductivity Picomhos per meter
12	10^{-12}	10^{-14}	1
1.2	10^{-11}	10^{-13}	10
0.12	10^{-10}	10^{-12}	100
0.012	10^{-9}	10^{-11}	1,000

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efficient additive to combat static electricity, contamination with these materials cannot be tolerated in most products.

There is an obvious need for additive substances capable of raising the conductivity very considerably at such a low dosage as to be acceptable in the products.

An important step in this direction was made by van der Minne and Hermanie[11] when they discovered the so-called "combination effect." It was found that certain additives could be combined to give a conductivity higher than the sum of the conductivities which the additives would give separately.

For the specific combination which is already being applied by the Royal Dutch-Shell Group, the relevant data are given in Table 4.

The substances concerned are the following:

1. The chromium salt of a mixture of C_{14}-C_{18} mono and dialkylated salicylic acids (Cr-AC) as already mentioned.

2. The calcium salt of di (2-ethylhexyl) sulfo succinic acid ("Ca-Aerosol OT," prepared from the sodium salt marketed as "Aerosol OT").

For practical use, the molar concentrations are conveniently converted into kilograms per 1,000 cu. m. or into pounds per 1,000 bbl. The two components have been used in the form of concentrated solutions containing 2.1 per cent by weight of chromium and 2.0 per cent by weight of calcium, respectively.

Accordingly, the dosage required to reach 1,000 picomhos per meter, which is approximately 0.4×10^{-6} kmol. per cu. m. of each component, corresponds to 1 kg. per 1,000 cu. m. of each of the two concentrated solutions, i.e., to 2 kg. per 1,000 cu. m. = 0.7 lb. per 1,000 bbl. for the mixed additive.

Experiments in Storage Tanks

In one set of experiments gasoline was pumped backward and forward between two identical 1,000-cu.-m. tanks (approximately 33 ft. in diameter by 43 ft. high) through 6-in. lines. One tank was provided with a field meter to measure the field strength at a point in the vapor space, the other with a metallic float making it possible to measure the current arriving at the float.

The results obtained at a flow velocity of 3.5 m. per second (= 225 cu. m. per hour) are given in Table 5.

The measurement of the field strength in the one tank and those of the current from the floating cover in the other show the same general trends:

At low values of the conductivity the electric effects very much increased in the presence of water and increased even further by subsequent addition of nitrogen. The latter increase is probably due to the higher linear velocity in the line and the more intense emulsification of the water in the gasoline. The importance of the presence of water, which was already indicated by the study of case histories of fires is thus confirmed.

If the conductivity is raised, first the field strength is suppressed and then, after the conductivity is raised further, the current. Even in the presence of water—where the electrification was most intense—at a conductivity of approximately 20 picomhos per meter, the field strength had become very much reduced. The current to the cover is then still considerable; later this is also reduced.

When pumping of the gasoline-water mixture is stopped, the field strength first drops rapidly (in the course of 1 to 2 minutes), then slowly (in the course of approximately 30 minutes). The value of the field strength at the break point is given in Table 5 under the heading "settling potential."

While the field strength in these measurements was already very much reduced at 20 picomhos per meter, the charging tendency of this gasoline had its maximum at far higher conductivity (highest value at approximately 150 picomhos per meter). It is therefore evident that the laboratory charging test cannot characterize products with respect to static hazard.

Experiments in a 13,000-cu.-m. tank (approximately 119 ft. in diameter by 46 ft. high) have also been carried out. These have confirmed the conclusions obtained for the 1,000-cu.-m. tank.

In all tests, in both the laboratory and the field, the electric charging of the liquid increased strongly with the flow rate in the piping.

TABLE 4—DATA ON ROYAL DUTCH-SHELL GROUP ADDITIVE COMBINATION, SPECIFIC CONDUCTIVITY IN PICOMHO PER METER

(Kilomols per cubic meter)

Concentration of Ca-Aerosol GT	Concentration of Cr-AC					
	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	0
10^{-3}	1,300,000	451,000	76,900	9,490	1,780	940
10^{-4}	1,360,000	342,000	63,400	7,720	910	110
10^{-5}	565,000	169,000	40,900	5,300	625	13.3
10^{-6}	509,000	45,900	16,300	2,670	342	1.83
10^{-7}	509,000	45,900	4,320	795	135	0.018
0	565,000	51,000	4,800	379	42	...

Experiments in 2-In. Pipes and Filters

The strong dependence of charging on linear velocity and the difference between 3-mm. tubes and 6-in. pipes caused us to investigate high-speed flow in 2-in. lines and in filters. The flow was directed into a small cylindrical, horizontal tank (0.63 m. in diameter, 2 m. in length) to stimulate the fueling of aircraft. The current to the tank and the field at the top of the vapor space could be measured. The measurements, as reported, refer to a tank filled to 0.20 m. from the top.

A strong dependence of the current on the linear velocity was again observed. In the 2-in. steel pipe, after correcting to infinite pipe length, the current was proportional to approximately the 1.75th power of the velocity.

Fig. 1 shows the dependence of the field strength on the electric conductivity for a constant linear velocity of approximately 9 m. per second. Two additives were examined, viz., Cr-AC and the corrosion inhibitor "Nasuleds."

Addition of Nasuleds in small amounts increased the field strength considerably. At increasing dosages the field strength passes through a maximum. At the maximum allowable dosage the field strength is, however, still higher than originally.

Thus, although Nasuleds can produce the conductivity desired for safety in certain refinery operations, according to the present tests electrification is still considerable when it is used in the maximum dosage.*

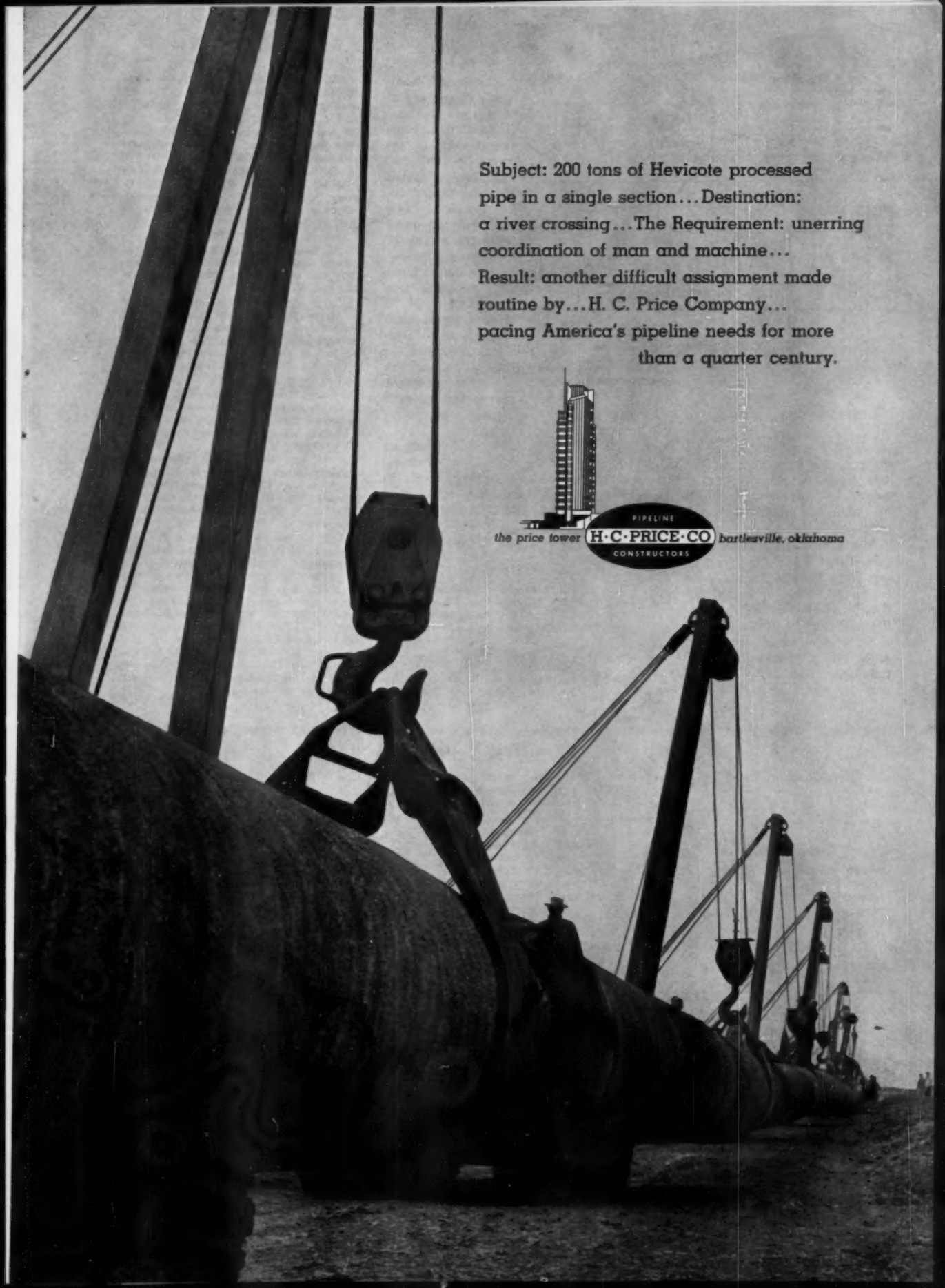
Cr-AC at equal conductivity caused less charging; moreover, at the same level of concentration the conductivity is much higher than for Nasuleds.

In filter experiments, raising the conductivity again reduced field strength and streaming current, and the conclusion was reached that a conductivity of of 500 picomhos per meter is desirable.

It is, of course, difficult to prove exactly what conditions are dangerous. However, in view of the inhomogeneity of the field, it is felt that measured field strengths on the order of 100 kv. per meter indicate that locally, much higher and possibly dangerous field strengths may exist in the tank.

Conductivities in the range where strong charging has been observed un-

*The liquid was kerosine; in less viscous and thus more volatile fractions the ions are more mobile and therefore the conductivity is higher.


Subject: 200 tons of Hevicote processed
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coordination of man and machine...
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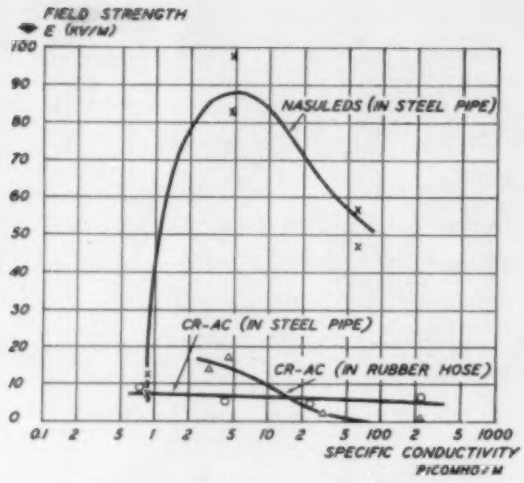

INFLUENCE of conductivity on field strength. Fig. 1.

der conditions simulating aircraft fueling (i.e., up to approximately 50 to 100 picomhos per meter) can be caused by natural contaminants and by additives employed for various purposes.

The general conclusion seems warranted that it is necessary to examine any dope for possible electric effects (unless an antistatic dope is also present, in which case only the compatibility should be investigated).

Since it is never possible to guarantee the absence of natural contaminants, and since other additives may be added for various purposes, the only safe solution is considered to be to raise the conductivity to a guaranteed value of approximately 500 picomhos per meter. The aim should be, for instance, 1,000 picomhos per meter for safeguarding of high-speed fueling. For storage tanks and tankers a conductivity of 50 picomhos per meter is adequate to safeguard operation, so that a conductivity of 1,000 picomhos per meter leaves a considerable safety margin.

The data on conductivity indicate that, by making use of the combination effect, this conductivity of 1,000 picomhos per meter can be reached at an extremely low dosage of additive, viz., 2 kg. per 1,000 cu. m. of product (0.7 lb. per 1,000 bbl.).

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TABLE 5—FIELD-METER AND FLOATING-COVER READINGS OBTAINED WITH AND WITHOUT WATER IN 1,000-CU.-M. TANKS

Additive, Cr-AC; flow velocity when pumping, 3.5 m. per second of 6-in. pipeline (=225 cu. m. per hour)

Cr-AC concentration (kilomols per cubic meters)	Field strength on field meter (kilovolts per meter)					Charging tendency (microcoulombs per cubic meter)	Current from floating cover (10^{-9} amp.)	
	Gasoline	Gasoline +6 per cent of water (=13.5 cu. m. per hour)	Gasoline +6 per cent of water +25 per cent of nitrogen	Settling potential	Conductivity (picomhos per meter)		Gasoline	Gasoline +6 per cent of water
6.10^{-10}	0.8	21	29	5.5	2.2	<±1	10 to —8	700
6.10^{-10}	1.0	66	....	....	....	....	....	....
2.10^{-9}	0.1	8.3	38.5	1.1	2.7	—1	20 to —20	270
2.10^{-9}	....	5.8	*25	1.7	....	....	....	....
10^{-8}	0.03	0.3	....	0.7	10	—14	15	—10 to 300
10^{-8}	0.3	1.5	4.4	....	....	....	....	....
10^{-8}	....	1.1	....	....	....	....	....	....
....	....	0.5	....	....	....	....	....	....
3.10^{-8}	<0.03	0.3	2.8	0.4 to 0.7	27	—21	—8 to 90	80 to 25
3.10^{-8}	....	0.4	1.2	....	....	....	....	....
3.10^{-8}	<0.03	....	2.3	0.35 to 0.76	15	....	....	....
3.10^{-8}	0.07	—1.0	1.4	....	....	....	....	....
....	—0.15	....	....	....	....	....	....	....
10^{-7}	0.04	....	0.2	0.3	90	—40	—1 to 18	25 to 200
10^{-7}	—0.03	....	0.5	....	....	....	....	....
10^{-7}	<0.04	0.1	0.7	....	40	....	....	....
10^{-7}	<0.04	0.1	1.2	0.4	....	....	....	....
3.10^{-7}	<0.04	<0.04	0.04	<0.04	145	—75	1.5 to 8	4 to 45
3.10^{-7}	....	....	....	....	100	....	....	....
10^{-6}	<0.04	<0.04	<0.04	<0.04	500	—22	—3	—3.5
10^{-6}	<0.04	<0.04	<0.04	<0.04	350	....	—4	—5

*Reduced rate of nitrogen injection.

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ATOMIC GEOLOGICAL CLOCK

By W. Jacque Yost

GEOLOGISTS need to determine the time which has elapsed since certain geological processes occurred. One effective method for making such time measurements depends on the radioactive decay of certain naturally occurring isotopes. Certain isotopes of uranium, thorium, potassium, and rubidium have been used to determine the dates of certain igneous and metamorphic processes.

In order to obtain more fundamental information concerning the use of these isotopes in the dating of sedimentary rocks, the A.P.I. Advisory Committee on Fundamental Research on Occurrence and Recovery of Petroleum established A.P.I. Research Project 53 in 1955. The research under this project, which is being conducted at California Institute of Technology, is concerned primarily with the use of the isotopes of uranium, and thorium, all of which decay to isotopes of lead.

Two of the initial studies have been concerned with the distribution of these various isotopes in the oceans of the world and their beach sands. Another study has involved the distribution of these isotopes in limestones which have been intruded by an igneous body.

The basic characteristics of all of this research is the manner in which both the radioactive and the sedimentary processes have been studied in order to provide better dating methods for the sedimentary process.

Age-dating of rocks . . . One of the outstanding achievements of geological science has been the determination of the time at which events took place during the past history of the earth. The petroleum geologist, especially has attempted to determine when a particular rock was first deposited, when it was altered, and when it first occurred in the present state in which he now finds it when he takes cuttings or cores from a wildcat well.

Author is with Ohio Oil Co., Littleton, Colo. Paper presented at annual A.P.I. meeting, Chicago, under the original title, "Age-Dating Rocks From Wildcat Wells."

By means of these measurements and the comparison of times, he then compares the few samples he has taken from his wildcat well with samples taken from another area in which the amount of information discovered may be much greater. Consequently, the determination of the time at which all of these things happened to the rock, or the age-dating, as it is commonly called, becomes very important to each petroleum geologist.

A great many methods for determining these times or ages have been developed throughout the history of geology. The methods themselves have been improved and refined until today it is possible to determine a great deal of the history of any particular sedimentary basin. The most prominent method, paleontology, consists of identifying the fossil remains of plants or animals contained within the rock. Inasmuch as various plants and animals are known to have lived at certain periods, the rock can be dated by means of these fossil remains. Other methods used by the geologist depend upon the rate at which various geological processes, such as sedimentation, take place.

Radioactive time measurement . . . However, since the discovery of radioactivity, there has been a strong belief among experts that the use of radioactive materials could provide a more accurate and more reliable geological clock for the measurement of such time. The basis for a radioactive time measurement is simply the fact that certain elements which occur throughout the earth's crust decay radioactively into other elements at fixed rates.

These rates are independent of practically all physical and chemical processes which can be assumed to have occurred during geological time. Consequently, the amount of material which has been transformed by this radioactive process is determined only by the length of time involved.

Furthermore, the rates at which some atomic species decay are so slow that a sample weighing only a few grams, which started decaying at the time of the formation of the earth, is still decaying today at a rate which can be measured.

In the early decades of this century, the only elements investigated were uranium and thorium. It was soon discovered that both uranium and thorium decayed into other elements, which then decayed into still other elements. This process continued through many steps, finally ending with one of the isotopes of lead. Also, during this process of transformation from uranium or thorium into lead, helium was being created.

Consequently, it was possible to follow the course of this radioactive decay by means of the measurement of either lead or helium. In many cases the helium, being a gas, was not completely retained within the mineral or rock being analyzed. The same type of problem occurred when a measurement of the lead was attempted. In this case, during the process of decay from uranium or thorium to lead, one of the intermediate products formed was radon, a gaseous material.

During the existence of the material in the form of radon, there is a possibility of escape of the radon gas. This is simply one of the errors one encounters in trying to determine ages by use of these methods. However, the most serious problem encountered during the early days of this work was that of the analysis of lead itself. It was impossible to assume that all of the lead measured in the sample originated from the thorium and uranium.

Consequently, very accurate analytical procedures to determine the elemental uranium, thorium, and lead were developed during the first few decades of this century.

Isotopes . . . During the 1930's, after the discovery of the neutron, a great deal of fundamental research was started concerning the nature of isotopes. In particular, it was found that

two isotopes of a single element differed only in the number of neutrons contained in the nucleus. All of this work on isotopes involved the construction of more accurate mass spectrometers, which were the instruments devised for the measuring of isotopic abundances.

With the use of these new mass spectrometers, it was possible not merely to measure the total amount of uranium, thorium, and lead in a sample but to measure the amounts of specific isotopes of these three elements. This increased precision of measurement and better understanding of the processes involved formed the beginning of the present science of dating geological samples by means of radioactivity.

This work was placed on a good foundation by the work of Professor Nier, of University of Minnesota. During the 1930's, Professor Nier not only designed and built several excellent mass spectrometers but, between 1939 and 1941, published a series of papers summarizing much of the work on geological dating by radioactive means.

New processes . . . Although World War II interrupted most age-dating work, it did produce better mass spectrometers as well as a number of people with the necessary training and interest to start age-dating research again at the close of the war. In addition to a renewed interest in the thorium and uranium processes, three new processes were studied, with the thought that they, too, might offer geological time clocks.

These new processes were the decay of radioactive potassium to calcium, the decay of radioactive potassium to argon, and the decay of radioactive rubidium to strontium. Thus, in the early 1950's when the A.P.I. Advisory Committee on Fundamental Research on Occurrence and Recovery of Petroleum was considering the support of research in this area, six processes were available for the determination of the age of geological samples.

Although a great deal of research was being conducted on all of these methods, most of the studies pertained to very old, igneous rocks. It was believed that possibly Institute support would encourage more research in the age-dating of sedimentary rocks, which are the rocks of primary importance to the petroleum geologist. In order to understand why most research workers preferred to work with older, igneous rocks, it is necessary to review briefly some of the analytical problems involved in a radioactive age determination.

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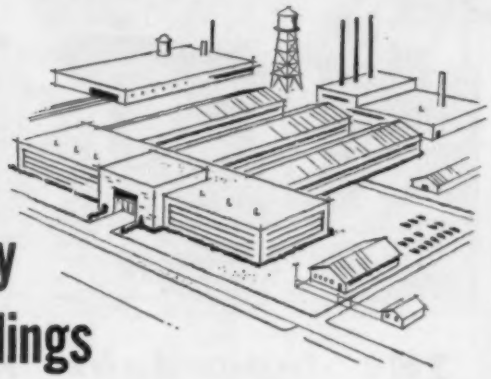

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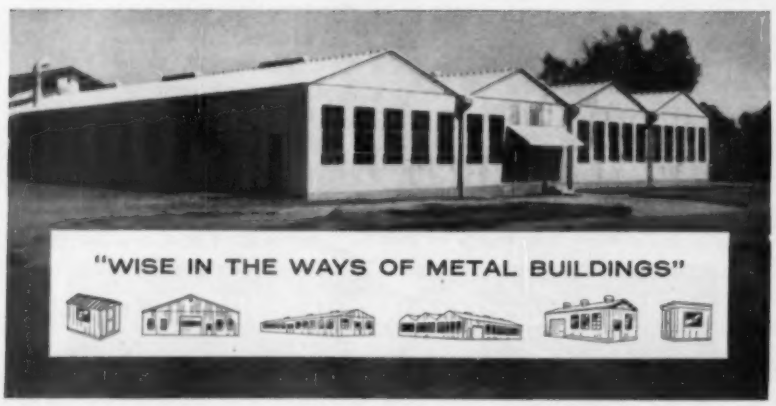

Each of the five radioactive isotopes, uranium-238, uranium-235, thorium-232, potassium-40, and rubidium-87, decays or is transformed into a stable isotope of some other element. The number of atoms decaying or transforming in a given length of time depends only upon the number of atoms of radioactive isotope in the sample, or, in other words, a certain percentage of the sample will decay or be transformed in a given length of time.

In the case of uranium-238, which is fairly typical, 1 per cent of the sample will decay to lead-206 in the first 65 million years. One per cent of the remaining sample will decay in the next 65 million years. This exact relationship will continue ad infinitum. Consequently, the older the sample, the more lead-206 it will contain and the easier will be the analysis of that lead-206.

Rare isotopes . . . The second factor which must be considered is that the five radioactive isotopes previously mentioned are extremely rare in the earth's crust. In fact, in order to perform the analysis at all, the researcher usually must look for minerals which contain one of these five isotopes in fairly large proportions.

Most minerals of this type are more common in igneous rocks than in sedimentary rocks. The final factor differentiating the study of sedimentary rocks from that of igneous rocks is the basic nature of sedimentary rocks.

Most sedimentary rock is formed by the weathering of older rocks or by the precipitation of atomic mixtures which have been redistributed by the solution process. Hence, many workers believe that age determinations of sedimentary rocks will yield reliable dates only if the research work combines the studies of the pertinent radioactive and sedimentation processes.

All of these objections are certainly valid. What they really say is that the problem of age-dating sedimentary rock is much more difficult than that of dating igneous rock. Just how difficult the problems are and what answers can be obtained will only be determined by very careful, precise research studies.

New research . . . The A.P.I. Advisory Committee on Fundamental Research on Occurrence and Recovery of Petroleum deemed it advisable to encourage research in this particular field. In 1955 they established A.P.I. Research Project 53, "Age-Dating of Sedimentary Rocks," at California Institute of Technology.

In addition, they established an A.P.I. grant-in-aid at University of Chicago, also in 1955. Project 53 has been running continuously since that time, first under the direction of Prof. Harrison Brown and more recently under the direction of Prof. Claire C. Patterson. In June of this year, the title of Project 53 was modified to "Geochemistry of Uranium-Lead Systems (Age Dating)."

Project 53 is simply one part of a broad program of research relating to the radioactive decay of uranium. Other aspects of the program are supported by Cal Tech and the Atomic Energy Commission. In addition to an excellent staff, the laboratory at Cal Tech has available some of the finest mass spectrometers in existence. The laboratory has been especially designed and controlled to keep contamination to a minimum and is equipped with sensitive and precise analytical equipment.

Inasmuch as it is possible for the lead in a given sample to come from many other sources, in addition to the radioactive decay of uranium and thorium, it is necessary to be very careful about two phases of such research work. In the first place, every possible source of lead other than the sample under investigation must be eliminated, insofar as possible.

In the second place, the sample itself must be studied from many points of view. In the case of the sedimentary rocks, this means studying the broad sedimentary processes and the relation of uranium, thorium, and lead to such processes.

Sedimentation Studies

In the beginning, work at Cal Tech was primarily concerned with samples of igneous rock and meteorites. However, since the inception of Project 53, a greater proportion of the time and effort has gone into studies relating to sedimentation. Three major projects, or parts of projects, have been started, relating directly to the processes involved in sedimentation.

This first project has been designed to determine the uniformity of the distribution of uranium, thorium, and lead isotopes in the oceans of the world. The first question to be answered is how uniform is the distribution of these various elements. Secondly, it is important to know exactly what that distribution is in quantitative terms. For instance, if the composition of a given ocean is extremely uniform, it could then be assumed that the mixing taking place in that ocean is extremely good.

If this is true, then it could be assumed that similar mixing had taken place in the past; consequently, the

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composition of the ocean water with respect to lead, uranium, and thorium isotopes would be quite similar to the composition of the sediments deposited or precipitated from the ocean.

The project has completed this study in enough detail to indicate that this mixing is extremely good in any one ocean. It has also progressed far enough to say that the concentrations in the Atlantic and Pacific oceans are significantly different. It is hoped that further research may uncover some of the reasons for the differences between these two oceans.

For those interested in sedimentation, one very interesting byproduct of this research is the method used to obtain samples. The amount of lead, uranium, or thorium in ocean water is so small that the collection of a suitably sized sample from the water itself would be extremely difficult. However, it has been discovered that manganese nodules on the floor of the ocean, which are formed by precipitation from the ocean water, tend to concentrate uranium, thorium, and lead in a very excellent, thorough, and uniform fashion.

Second phase . . . The second phase of the work in sedimentation age-dating involves the determination of the relative amounts of these three elements in beach sands collected from all over the world. This phase of the work has not progressed to the stage of yielding any significant results in terms of the correlation of the compositions from different sands. However, sands contain enough of these elements for satisfactory analysis, whereas others do not.

The third relates to the Leadville, Colo., limestone in an area where a large intrusion and secondary mineralization have occurred. The uranium and thorium studies of Project 53 on these samples are being closely tied in with the paleotemperature work being performed by another group.

At the present stage of this work, it can only be concluded that there are significant differences in the uranium, lead, and thorium content in the various known samples. Of greater significance, perhaps, is the fact that the limestone body far removed from any intrusions does contain enough lead to make a satisfactory mass-spectrometer analysis.

However, this amount of lead is orders of magnitude less than that dealt with in the earlier studies. Consequently, it has been necessary to restudy all analytical procedures in order to reduce the lead contamination from other sources.

Limestone samples . . . A good example of the contamination problem is evident in this work with the limestone samples. These samples contain about half as much lead as 1 cu.m. of Pasadena, Calif., air. In addition, a great deal of contamination is carried in by workers on clothing, shoes, etc. Furthermore, enough lead is dissolved from Pyrex glass during the entire analytical procedure to present a severe contamination problem. **End.**

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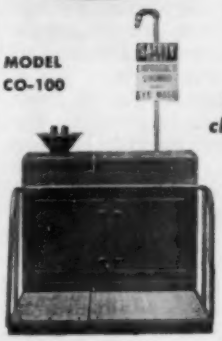

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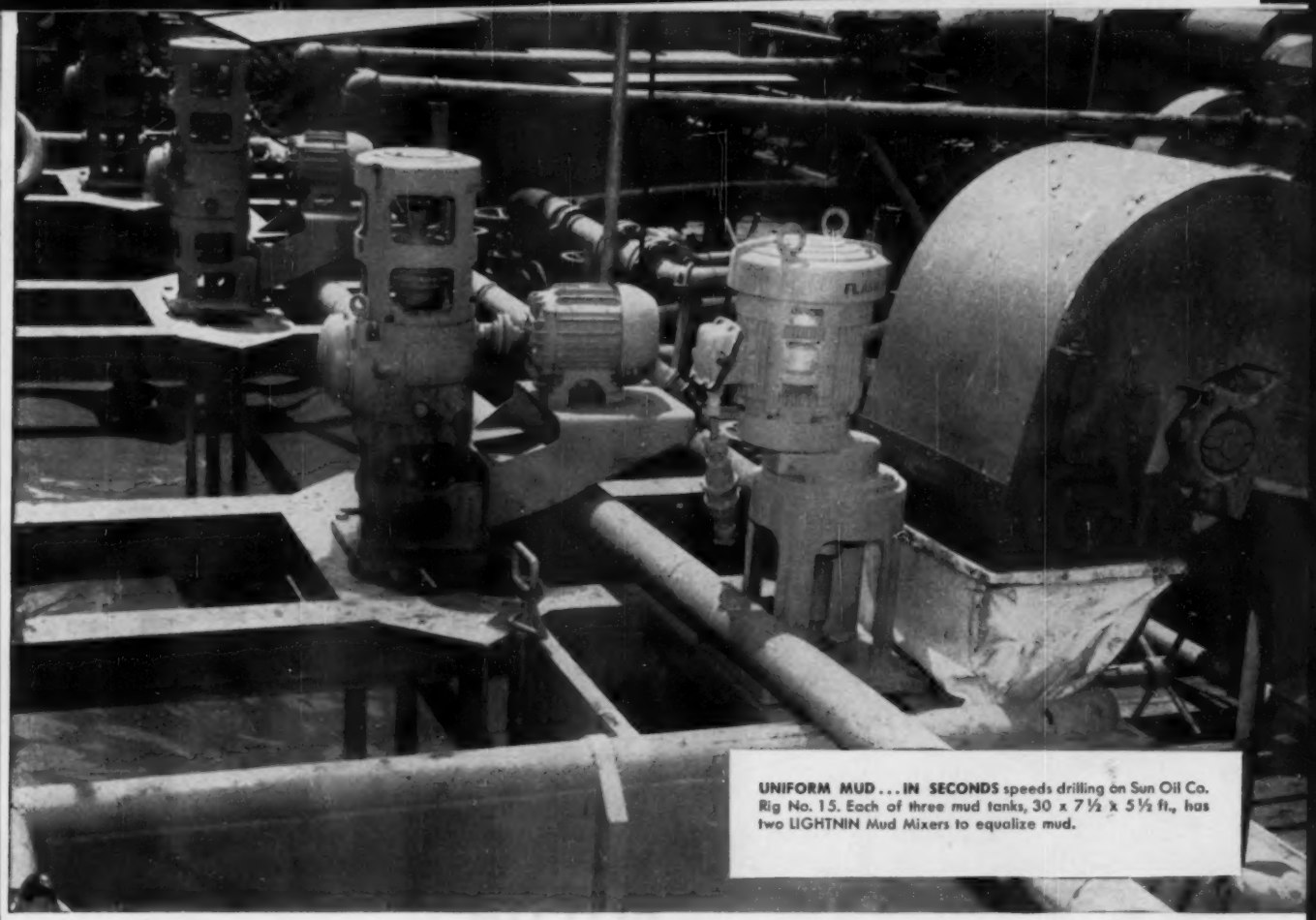

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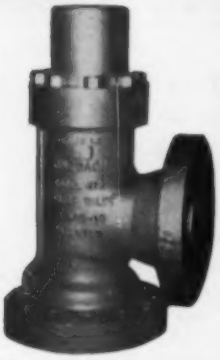

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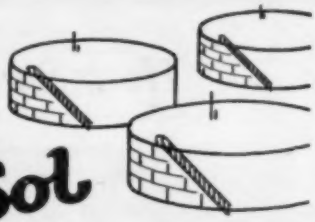

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QUESTION:

How to Upgrade Personnel

to keep pace with mechanization

By Kenneth Curtis

RECENTLY steps taken by some domestic companies to cut back producing activities, to close refinery installations, and concurrently to continue to earmark considerable sums of capital expenditures have thrown into sharp relief the problems posed by outmoded facilities and the impact of competition. Pinched by the ever-increasing cost of doing business, by intensive quality and service competition, and by the problem of meeting expected future increases in demand, managements face the dual need for rigorous belt-tightening while pressing forward on costly projects for discovering new oil reserves and for improving quality, service, and productivity.

These pressures hit the producing phase of the business at a time when many developments, including the automatic custody transfer of crude oil, the extended application of electronic computers as self-correcting control devices, automatic control of drilling, automatic well-testing, and so on, are emerging from the research and experimentation stage and are beginning to be applied. Thus, the possibilities for extending mechanization are revealed at the same time that economic and other considerations dictate a quickened pace in applying these new devices.

Among the several factors which will limit or further the degree to which companies gain expected benefits from advanced processes, equipment, and methods is the availability of people with the required skills to design, build, operate, and maintain them. Even today this problem is acute, as is illustrated by the shortage of engineers, computer operators, management people, and skilled craftsmen.

When we look as far ahead as 1965, we see, from a United States Labor Department forecast, that we will need 10,000,000 additional people in our labor force in order to produce the goods and services needed for an estimated population of 193,000,000. We will need, it predicts, 137 professional and technical workers for every 100 we had in 1955, 124 skilled craftsmen for every 100 in 1955, and 127 clerical and sales people for every 100 in 1955.

This situation dramatizes the demand for a greatly increased output from our educational system. But, because the supply of people in the normal working-age brackets will remain relatively stable because of the low birth rate of the 1930's, the competition between companies for professional and skilled people likely will be severe. This will lead to greatly expanded utilization of such manpower sources as older people, women, and the physically handicapped. It also underscores the need for and the great advantages of upgrading the skills of our existing employe force.

It is obvious, however, that we cannot afford to view the prospect of upgrading simply from a training and promotion standpoint, if only because the impact of technological change on other aspects of employe relations affects the prospects for most effective utilization of our manpower resources. Thus, it is desirable to mention briefly some of the factors which must be recognized and dealt with in a period characterized both by mounting pressure on costs and by technological change.

Basis for Policy

It would be fair to say that the present state of the petroleum industry's health in employe relations derives from two principal factors, among others. One is the industry's belief in enlightened personnel policies. The second is that, by and large, companies have had the money to carry out these policies.

For many years, the petroleum industry has provided real differentials in earnings and generous employe benefits in comparison to American industry generally. Now other industries are catching up in these respects. The present and probable future strong upward pressure on costs and strong intraindustry competition should certainly increase the economic value of sound personnel policies. At the same time it will very likely call for reappraisal of management thinking in such areas as wage and benefits policy. Indeed, the whole body of management policy in employe relations requires periodic appraisal as part of the process of measuring the effectiveness of management action. What was a sound structure of policy 10 years ago may not necessarily be appropriate tomorrow.

In addition, managements will have to extend their already substantial means of providing recognition of employes as individuals, of considering employes' aspirations and providing for maximum job satisfaction. In the recent words of the Secretary of Labor: "Technology has not replaced people. It has placed an exclamation mark upon their individuality."

Author is with Industrial Relations Counselors Service, Inc., New York. Paper presented at A.P.I. annual meeting, Chicago, under the original title, "Upgrading Personnel to Keep Pace with Mechanization."

These considerations, among others, point to the need to undertake long-range planning in employe relations for the same reasons that dictate the necessity for such planning in the areas of production, marketing, and finance. Thus, it now is and will be essential to take advance account of the impact of extending mechanization on jobs, skills, earnings, group relationship, motivation, employment levels, and other aspects of human relations.

One aspect of forward thinking will have to be concerned with estimating the need for, and considering where necessary, special programs to ease the impact of technological displacement of employes during a period of transition and replacement. Will there be need, for example, of special retirement allowances and special layoff allowances during temporary unemployment, pending possible reassignment? The objective, of course, is to work toward achieving readjustment of the work force through planned action rather than through crisis adjustment.

Preparing Employes

The future course of mechanization in the petroleum industry—coupled with the expected increase in demand for petroleum products—may expand employment opportunities, rather than throw people out of work. However, the extensive changes probable in operations and processes may further increase the proportion of white-collar to blue-collar jobs, may create short-term unemployment, may result in new jobs, and may require the realignment of existing ones.

Outmoded facilities may be closed and new ones built, perhaps in more economically favorable locations. Unless employes understand the need for such changes and are led to see that they involve better and more secure jobs for the majority of employes, resistance and conflict may erupt. Oil-industry communications programs—as good as they are—must be reappraised in the light of this enlarged task, particularly in view of the scare stories and conjectures about fully automatic plants and operations which have appeared in some current publications.

Upgrading Employes

Since World War II, one of the significant developments in American industry has been the great growth in management training and development as a continuing, rather than one-shot function. These programs have arisen in response to a present and prospective shortage of skilled management manpower of substantial dimensions. Out of this experience have come approaches and techniques which offer considerable promise for adaptation to the problem of upgrading personnel to keep pace with mechanization.

The most successful company programs encompass four separate but integrated activities. The first of these is organization planning. Put simply, this activity is concerned with improving the company's present organization as well as studying the kind of organization the company wants to evolve. It involves consideration of these questions: What kind of management jobs do we have today? What kinds of jobs will we have in the future? How many of these jobs will we have? What should be the qualifications of the people who will hold them?

The second activity is the inventorying of the qualifications and experience of these now holding management positions in the company. This is not limited to record keeping in quantitative terms but is directed toward the development of reliable methods of performance appraisal and prediction of growth potential to identify those who can be promoted and when.

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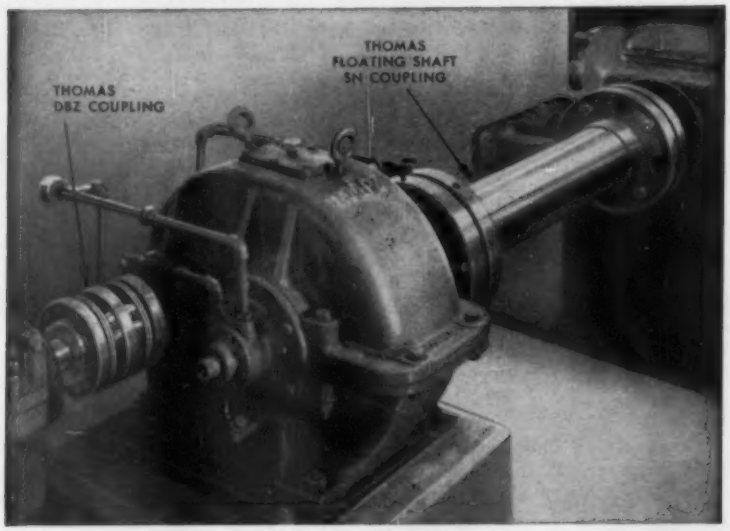

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together the anticipated future requirements of the organization and the present capacities and potentialities of existing employes. This is a process of measuring the gap between what the company has and what it will need and of determining what must be done to fill that gap, either by means of training individuals presently employed or by recruiting people from the outside.

The fourth activity is directed to the construction of training and development programs for the individuals concerned, in response to the specific needs disclosed by the other three activities. Generally speaking, such programs make supplementary use of formal training, either inside or outside the company, and rely increasingly upon on-the-job training, coaching and guidance by superiors, and experience exposure through job rotation.

Although this oversimplifies the dimensions and complexity of modern management development programs, it illustrates a framework within which the problems of upgrading may be approached.

1. Planning for the future . . . It seems inescapable that the techniques of organization planning must be adapted to production, technical, maintenance, and service occupations within our companies and not be confined to management ranks. Advance estimating of the numbers of and the qualifications required for the jobs of the future would seem to be as important as planning the design and installation of the quipment to be operated.

We must know, furthermore, whether the technological changes we may find it possible to make actually will produce significant changes in the proportion of direct labor costs to total costs. If a higher proportion of indirect labor results, this not only has significance in terms of unit costs and the employe mix of the company's labor force, but it also has important implications for employment stabilization.

Highly trained professional, technical, maintenance, and supervisory people cannot, of course, be laid off and rehired as production volume changes. Their skills are needed just as much during periods of lower scheduled production as during periods of high volume. Moreover, there are too many other markets for their skills to justify such action. This proposition, of course, has been long recognized and applied in the refining end of the business.

We also must know whether more highly mechanized processes actually will, in specific cases, permit job enlargement. Although this appears to be the case in some of the processes now being developed in the producing end of the petroleum business, we need to be sure as a basis for our training efforts, for purposes of overall manpower planning, and for anticipating the human problems of adjustment to these changed jobs.

For example, recent advances in machine design seem to encourage a specialization of skills, with a trend away from the maintenance man of universal skills. Equipment may become so complex that the premium will be placed on diagnosis of trouble, rather than repair. What effect should such developments have on our selection standards and training programs?

In addition, we need to survey the impact of technological change with respect to the jobs which will be eliminated, as well as changed or created. When we have assessed these prospective changes, we then consider the next question—**when** are the changes to take place? Such timetable planning not only is the basis for planning the utilization of people at their highest capacities but also helps avoid the high cost and relative ineffectiveness of crash training programs and provides a basis for meeting the many human relations and collective bar-

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gaining problems brought on by extended mechanization.

2. Analyzing what we have . . . Generally speaking, the personnel records we maintain, when put to the test of a search for people in our organization with particular qualifications, often reveal no more than a record of changes in wage rates and departmental assignments. If we really believe in promotion from within, we had better have the techniques to support the policy.

Of course, the answer to this question goes beyond the improvement of personnel records and the utilization of such tools as electronic business machines to give us a quick search for specific talent in our organizations. It also requires study and research on the possibilities for extending performance appraisal and rating techniques to hourly rated and lower-level salary jobs and the application of valid and reliable trade-knowledge, aptitude, and other psychological tests to the employment and selection process.

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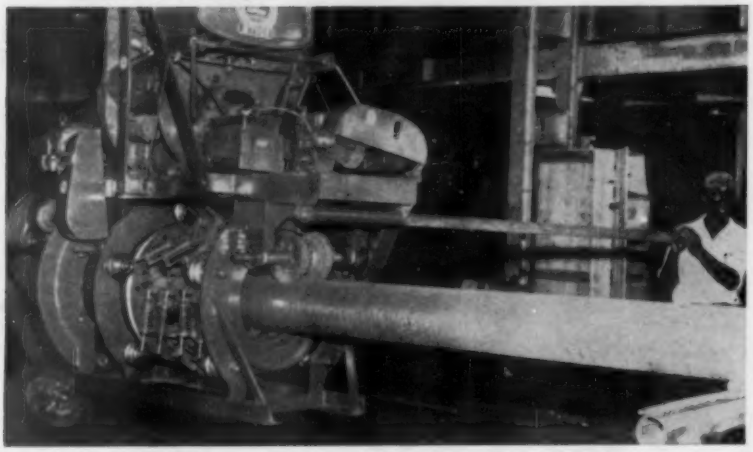

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3. Measuring the gap . . . After the first two steps are taken, we are then in a position to chart the training needs of the organization and of individuals in it, and to determine the extent to which we will be able to promote existing employes or to look outside the organization for new talent. Development of such a long-range plan also enables us to evaluate our recruitment programs, employment standards, and selection techniques and to adjust these in conformance with emerging needs.

Experience in the petroleum industry amply indicates that the introduction of new processes and equipment very often discloses training needs which are not confined to the specific process being improved. The effect is a chain reaction of new requirements placed on lower-level supervision and throughout the whode management structure.

Not only does management have new things to learn in order to supervise the operation and maintenance of this equipment, but it must be prepared for the human-relations problems incident to technological change. These considerations indicate the need to measure the gap between today's and tomorrow's management skills and to account for these needs in the framework of training activities.

4. Training for upgrading . . . It is impossible to propose here the dimensions of an appropriate training program to meet the needs brought about by extended mechanization. General Electric Co., for example, currently conducts more than 1,000 courses to train or retain employes. It also stimulates secondary-school students by its science show, "House of Magic," provides career-guidance material, summer fellowships for high-school teachers, financial help to colleges, work-study programs, and a comprehensive program of management education. It is obvious, therefore, that training needs can be met in several different but related ways, some of which are outside the company fence.

Any generalizing about the training needs brought about by technological change may leave the unfortunate impression that companies should embark on a crash basis on a great variety of long-range and costly training programs. If there is an immediate need, of course, it should be met; but the point to be stressed is that any formalized training must be based on demonstrated need. The advantage of the planning process previously outlined is that needs can be predicted and programs developed in an orderly fashion.

Much of this planning process will

be a staff function in larger companies whereas line people will have this responsibility in smaller organizations. In any case, the actual decisions about timing, content, and scope of training activities, and in many cases the actual training itself, is a line management responsibility.

In the future, it seems likely that our internal training efforts will have to be directed toward the following problem areas:

1. Providing for the development of new skills among employes displaced, or to be displaced, from their former jobs but who are needed on other types of more demanding work. For example, it may be necessary to provide training in hydraulics and electronics for machine repairmen and electricians whose apprenticeship programs lacked these elements years ago. This type of training may be longer and more intensive than many of us in industry have had experience with, even in those companies with well-developed apprentice-training programs.

2. Providing programs to develop nontechnically trained employes to handle semitechnical and other specialized assignments in a variety of fields. For example, when an automatic-custody-transfer installation is planned, pumpers and gagers may be selected for training covering instrumentation and preventive maintenance.

Apprentice-training programs — perhaps adjusted to admit older employes—and other work study programs can fill an expanded role in this area. In some companies, closed-circuit television might be used as a training medium, particularly for "how-to" demonstrations on new equipment. Some companies—such as General Motors with its training centers—are setting up separate schools for skills and professional training.

3. Providing for job rotation and experience exposure apart from formal classroom or specialized on-the-job training. These approaches will be increasingly significant as technical coordination between mechanized processes requires understanding by an individual of operations other than his particular specialty.

4. Providing for supervisory training and management development. These programs, which have received so much recent management attention, undoubtedly will continue to be important aspects of company training for many years to come. Not only will supervisors and managers need to acquire increased technical knowledge but they will face new human-relations problems for which they must be prepared. Although many of these problems may develop in the future, some may be anticipated today and form the basis for transitional training.

One large rubber company, for example, has developed a comprehensive four-session training program for supervisors entitled "Automation—Key to Productivity." The sessions explore the nature of automation, why resistance to it may develop, the progress the company has made in its application and problems, and prospects for the future. It makes use of group discussion, flannel-board presentations, and films and has received a high degree of acceptance and approval from the supervisory group.

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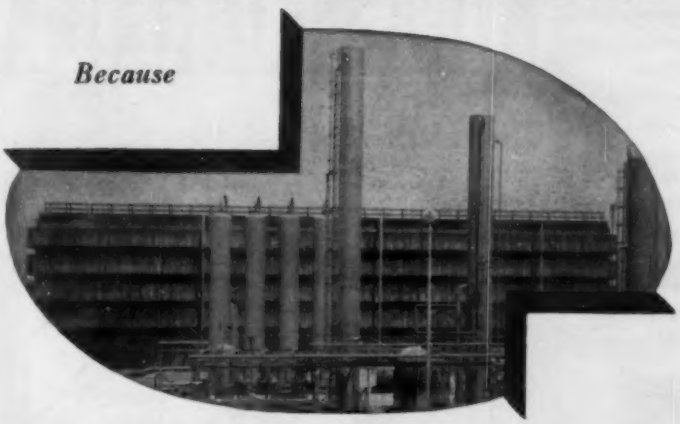

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longer, he discovers that he has retained people in his employ who simply are not equipped to war on costs or meet the competitive challenge. Perhaps, worse, he may discover that, at the expense of opportunity, an emphasis on career employment has grown up.

He may also discover that some people originally were improperly selected for development and that others, who could have improved their skills or acquired new ones, were neither guided nor pressed to do so. He then must: (1) decide whether to retain such employes out of loyalty for their past service, (2) hope that attrition will solve his problems; (3) separate them, with costly supplements to the basic benefit program; or (4) adopt other less-desirable courses which may jeopardize the fabric of his employe relations. To the extent such adjustments—particularly in the management ranks—are required, the sooner they are faced up to, the more responsive our organizations will be to the tasks ahead.

While modern management techniques, such as decentralization, improved management controls, and long-range planning—to mention only three—can help us avoid the high cost of complacency and obsolescent practices, there is urgent need to devise additional means of keeping our organizations tough and flexible, to meet the demands of the future without resorting to the wasteful hire-and-fire labor policies of the distant past. This is partly a question of management manpower planning and development and partly a question of upgrading management methods and attitudes.

Collective Bargaining

Will our collective bargaining and group-relations approaches and practices be adequate for the tests ahead? Will companies be successful in protecting their ability to select the people for training or will unwise seniority restrictions hamper and obstruct them? What about the impact of new jobs on job classification and wage-rate structures? What about the thorny question of contracting for maintenance work? Are there other forms of mutual-consent arrangements which need to be removed from existing contracts or guarded against in the future?

In a recent address, the research and education director of the A.F.L.-C.I.O. summarized seven major areas in which unions will attempt to meet the adjustment problems arising from automation. These are: (1) protection of wage income in time of accelerated technological changes; (2) improvement-factor provisions and shorter hours; (3) dismissal pay; (4) reexamination of the engineering methods of wage determination; (5) traditional union and job-security devices; (6) union training programs; and (7) creation of automation committees and contract clauses on automation.

These questions point to the need for management to devote serious attention to the collective-bargaining implications of technological change, particularly the implications of the shift in the company work force toward higher percentages of technical and professional people. These matters, as well, pose the opportunity for statesmanship on the part of labor leaders. As Peter Drucker puts it: "Union leaders, too, should similarly accept responsibility for the changes in their rules that will be necessary. Even such sacred cows as seniority or apprenticeship restrictions may have to be slaughtered." Although capital investment will continue to be the key to increasing productivity, we can be sure that the maintenance of favorable relations with employes will be a critical factor in management's efforts to insure continued profitability of the industry. **End.**

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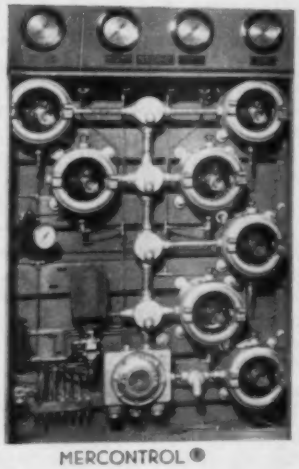

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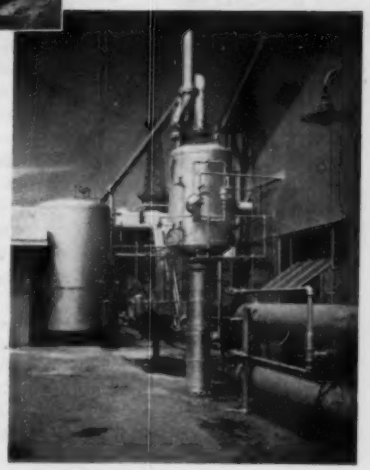

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Oil—No. 1 Transportation Job

Here's a look at the problem of getting oil from where it's produced to its far-flung markets . . . and how the various forms of transportation rate in preference, and why.

By H. N. Emerson

PETROLEUM transportation, exclusive of gas transmission, is a major activity in the American industrial economy. The tonnage originated by this industry stands at the top of the list along with bituminous coal. Petroleum tonnage is greatly in excess of such commodities as iron ore and other minerals, oats, wheat and other farm products, and the products of the forest.

Daily, our refineries process more than 8 million barrels, or 1 million tons of crude oil. The average hauls to and from the refineries are long. This generates huge requirements in ton-miles of transportation work to be performed.

It is evident that the petroleum industry surmounts all transportation problems. The facts speak for themselves. Wherever crude oil is producible in commercial quantity, it is moved to market. The ubiquitous gasoline pump is symbolic of the transportation coverage provided to meet the requirements of the ultimate consumer.

In appraising oil-transportation preferences from the viewpoint of a businessman and economist, the subject lends itself to treatment in three parts: (1) the utilization of oil transportation in the United States; (2) the principal criteria applicable to an evaluation of each functional method of transportation; and (3) the comparative appraisal of each transportation method in terms of these criteria.

Author is with the Atlantic Refining Co., Philadelphia. Paper presented at A.P.I. annual meeting, Chicago, under the original title, "Oil Transportation Preferences—Their Bases."

Utilization of oil transportation . . . Let us look at transportation utilization in these ways: (1) ton-miles of transportation service performed between the well and the point of consumption of the finished product; (2) physical equipment used; and (3) transportation capacity. Although our analysis is confined to American industry, it seems appropriate to include the inbound crude-oil movement from origins outside the continental United States because this is an integral part of the industry's economy.

TABLE 1—RELATIVE USE OF PETROLEUM TRANSPORTATION METHODS

	Annual service*	Percentage
Marine:		
Ocean tanker:		
American flag	256	33
Foreign flag	262	33
Inland and coastal waterways, barge fleet	23	3
Petroleum pipeline:		
Crude-oil trunk line:		
Domestic	153	20
Foreign (Venezuela, Canada, and Middle East)	11	1
Product pipeline	36	5
Transport trucks	17	2
Railroad tankcars	22	3
Total	780	100

*1955. In billions of short tons.

Table 1 shows the amount of line-haul service used to provide the bulk-transportation framework of the American petroleum industry. This is expressed in short ton-miles, i.e., the work of moving a 2,000-lb. ton 1 mile. Ocean tankers provide two-thirds of the bulk transportation used by the American petroleum industry.

The equipment used in transporting bulk petroleum can be summarized in a general way. Physical facilities may be described in terms of the number of units and their shell capacity. Table 2 is representative of the equipment used in petroleum service. This table stresses relative sizes. It brings out, for example, the considerable size of the inland-waterways fleet.

Transportation capacity expresses how much transportation service can be produced by the equipment. Table 3 shows the barrels or tons of petro-

TABLE 2—QUANTITY OF TRANSPORTATION EQUIPMENT, 1955

	Number of units	Capacity		
		Barrels, in millions	Short tons, in millions	Per cent
Ocean tankers:				
American flag, T-2 equivalent	253	30.6	4.5	18
Foreign flag supplying the United States, T-2 tanker equivalent	269	31.3	4.6	18
Inland and coastal waterways barge fleet, barges	2,108	25.2	2.9	11
Crude-oil trunk pipelines:				
Diameter less than 14 in., miles	64,500	24.9	3.7	
Diameter 14 in. and larger, miles	14,200	28.8	4.2	
		53.7	7.9	31
Product pipelines:				
Diameter less than 14 in., miles	34,300	12.5	1.8	
Diameter 14 in. and larger, miles	2,100	2.3	0.3	
		14.8	2.1	8
Railroad tankcars	90,000	18.9	2.8	11
Transport trucks	36,000	4.8	0.7	3
Total		179.3	25.5	100

TABLE 3—REPRESENTATIVE TRANSPORTATION CAPACITY

Equipment—	Service	Delivery ability— Bbl. per day	Short tons per day	Ton-miles service‡
16,000-ton T-2 tanker*	U. S. coastwise or Venezuela to North of Cape Hatteras	8,540	1,225	2,600
30,000-ton tanker*	U. S. coastwise	18,200	2,610	5,690
45,000-ton tanker*	U. S. coastwise	26,350	3,790	8,040
45,000-ton tanker*	Persian Gulf to U. S. via Suez	6,420	923	9,050
100,000-ton tanker*	Persian Gulf to U. S. via Cape, light via Suez	11,000	1,580	†18,600
70,000-bbl. integrated river tow	Gulf Coast to upper Ohio or Mississippi rivers	2,340	334	750
	Haul, in miles:			
24-in. crude oil pipeline	1,000	360,000	53,800	53,800
	500	360,000	53,800	26,900
12-in. crude-oil pipeline	1,000	72,000	10,700	10,700
	500	72,000	10,700	5,350
12-in. gasoline line	500	96,000	12,400	6,220
10,000-gal. tank car	1,000	17	2.26	2.3
	500	17	2.26	1.1
	250	17	2.26	0.6
	100	19	2.62	0.3
6,000-gal. transport truck	400	72	10.0	4.0
	200	143	20.0	4.0
	100	286	40.0	4.0
	50	429	60.0	3.0

*Tanker size expressed in long tons, deadweight capacity. †Equivalent figure, Venezuela or Gulf Coast to North of Cape Hatteras, is 16,030. ‡Daily, in thousands of short tons.

leum delivered daily under prescribed conditions. This table emphasizes the difference in capacity of various kinds of equipment.

In Table 3 the column to the extreme right shows the ton-miles of transportation service produced daily by various types of equipment. The ton-miles are not affected materially by the assignment. Capacity is governed by the size and speed of equipment, distance to be covered, and turnaround time at loading and discharge points. For example, a tanker operating on the U. S. Gulf to North of Cape Hatteras run will deliver approximately 4.3 times as much as it will deliver on the longer Persian Gulf to Suez to U. S. East Coast run.

The railroad-tank car data point up the anomaly that tank car-delivery ability is not a direct function of distance. This is because of the time consumed by the rail carriers in shifting, yard work, and interchanges.

Factors underlying preferences . . . Next, we turn to a consideration of the factors which underlie the preferences for each transportation method. Four broad features are evident, but service must come first. To be chosen, a method must at least meet minimum service requirements. The quality of service by one method may be sufficiently superior to overcome a cost disadvantage when contrasted with an alternative method.

Minimum service levels may be set by operating considerations, customer preferences, or by that most compelling of drivers—competition. Coupled with service is the all-important matter of safety. The commendable record of the petroleum carriers is attributable to the constant attention devoted to safety in all of its aspects —design, construction, maintenance, and operations.

The third element, ranking after service and safety, is price. This means the dollars-and-cents considerations in all of their complex aspects. The fourth feature is encompassed by the term "availability," which may cover the selection of existing services, routes, and equipment, the more complete utilization of what is available, or the provision of entirely new services.

The matter of gross volumes, regularity of movement, and expected life of the business are especially important in this respect. That importance is apparent when a transportation method requires heavy investment in equipment and facilities which have a long life.

A discussion of preferences for transporting petroleum in one way rather than another implies that there are alternatives. This must be viewed broadly because, in a given circumstance, conditions may appear to dictate which method should be used. For small volumes, moving relatively short distances between interior points, a transport truck may appear to be the only desirable method.

Admittedly, this is true. However, it is well to recognize the pervasive influences of three forces: competition, complementation, and logistics. Some transportation methods are directly competitive to an area: tankers and pipelines are often in competition, as are transport trucks and railroad tank cars; a product pipeline may be directly competitive with tank cars, trucks, or barges. On the other hand, there are important complementary relations between the methods. A pipeline plus a transport truck may represent a working combination, neither of which alone would receive the preference. Consequently, some preferences should be viewed as composits.

Finally, there is the matter of overall logistics. Logistics may introduce considerations which override competition between methods or carriers serving an extensive area. Look at some representative situations:

The discovery and development of crude oil in Canada's prairie provinces, and the construction of crude-oil pipelines to the Great Lakes area and to the Pacific Coast, had repercussions on the carriers and sources displaced. When crude oil was discovered in southern Illinois some years ago, we know how it altered the demand on carriers supplying the important Great Lakes markets.

The availability of foreign crude oil, plus transportation by large foreign-flag tankers, introduces an element in the supply picture for the North Atlantic states with which we are all familiar.

Comparative Factors

Attention may now be directed to the several specific factors which combine in varying proportions to influence the preferential position of each transportation method. The more important of these factors relate to: (1)

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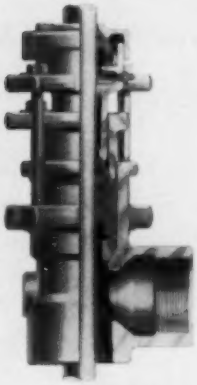

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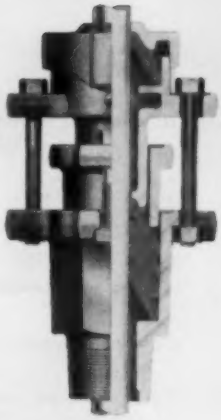

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material, (2) manpower, (3) power, (4) fuel consumption, (5) load factor, (6) terminal facilities, (7) inventories, and, (8) costs.

Materials . . . The quantity of materials used in providing a transportation service may be expressed in a rough way in terms of equipment weight. Table 4 shows typical weights. An increase in net or payload per ton of equipment results when the size of the carrier increases.

This varies markedly as between methods and also between sizes of equipment—tankers, for instance. An increase in the ratio of cargo to equipment weight represents one of the fields constantly receiving attention from operators, designers, and manufacturers. The trucking industry has been especially active in this respect.

Manpower . . . The relation between manpower and transportation service is shown in Table 5. The high productivity per man has been a result of the huge capital investment made in transportation equipment. Here, again, the desirability of operating larger equipment is apparent. It should be noted that, although the indications and inferences to be drawn from the data are useful and reasonable approximations, there is some lack of uniformity.

The tanker personnel represents men aboard ship, excluding the supporting shore organization. The pipeline personnel cover not only the field operating force but also the supporting maintenance and administrative staff. And with the transport truck, only the man at the wheel has been included.

Perhaps the railroad figure in Table 5 is especially revealing to us in the oil business. On specific runs of tonnage trains the cargo per train-crew member can be in the area of 1,000 tons per man on the loaded movement.

This fight might make us believe that the railroads are in a preferred position to perform a high-volume line-haul service. You will recognize that taking simply the train crew gives only that portion of the picture because maintenance of way, switching, yard operations, supervision, administration, clerical, etc., have not been added.

It is proper to note that there are substantial manpower requirements in addition to those required for the line-haul movement. These requirements vary from method to method. At one extreme the transport-truck driver stands ready to handle the related loading and unloading service.

TABLE 4—MATERIALS

Equipment—	Equipment weight*	Cargo weight*	Ratio of cargo to equipment: Loaded	Ratio of cargo to equipment: Round trip	Ton-miles* service produced daily per ton of equipment
16,000-ton T-2 tanker	7,140	17,400	2.44	1.22	364
30,000-ton. tanker	11,250	32,400	2.88	1.44	505
45,000-ton. tanker	15,220	48,800	3.21	1.60	527
100,000-ton tanker	26,400	109,400	4.15	2.08	608
70,000-bbl. integrated river tow	2,875	10,000	3.48	1.74	261
1,000-mile pipeline:					
8 in. in diameter	85,000	48,200	0.57	0.57	44.2
12 in. in diameter	150,000	105,500	0.70	0.70	71.4
16 in. in diameter	185,000	153,900	0.83	0.83	96.5
24 in. in diameter	280,000	396,000	1.41	1.41	192.0
10,000-gal. railroad tank car†	25	32.8	1.32	0.66	22.8
6,000-gal. truck tractor semitrailer‡	10	20	2.0	1.0	400

*Weight expressed in short tons. †Delivery of 250 miles. ‡Delivery of 100 miles.

TABLE 5—MANPOWER

Equipment—	Personnel	Cargo weight* (in tons)	Cargo per man (in tons)	Ton-miles* service produced daily per man
16,000-ton T-2 tanker†	41	17,400	425	63,500
30,000-ton tanker†	41	32,400	789	138,500
45,000-ton tanker†	45	48,800	1,085	178,500
100,000-ton tanker†	50	109,400	2,190	322,000
70,000-bbl. integrated river tow	28	10,000	357	26,800
1,000-mile pipeline:				
8 in. in diameter	250	48,200	193	14,300
12 in. in diameter	275	105,500	384	38,900
16 in. in diameter	275	153,900	559	64,900
24 in. in diameter	275	396,000	1,440	195,800
10,000-gal. railroad tank car‡	6	6,000	1,000	
6,000-gal. truck tractor semitrailer	1	20	20	2,000

*Weight expressed in short tons. †Tanker size expressed in long tons, deadweight capacity. ‡Tonnage train movement.

TABLE 6—POWER

Equipment—	Installed horsepower	Cargo weight*	Cargo per horsepower	Ton-miles* service produced daily per horsepower
16,000-ton. T-2 tanker†	6,600	17,400	2.64	394
30,000-ton tanker†	13,500	32,400	2.40	421
45,000-ton tanker†	17,000	48,800	2.87	472
100,000-ton tanker‡	27,000	109,400	4.05	595
70,000-bbl. integrated river tow	3,200	10,000	3.13	234
1,000-mile pipeline:				
8 in. in diameter	10,000	48,200	4.82	357
12 in. in diameter	27,000	105,500	3.91	396
16 in. in diameter	39,300	153,900	3.92	454
24 in. in diameter	74,000	396,000	5.35	727
10,000-gal. railroad tank car‡	5,000	6,000	1.20	
6,000-gal. truck tractor semitrailer	175	20	0.11	23

*Weight expressed in short tons. †Tanker size expressed in long tons, deadweight capacity. ‡Represents a tonnage train.

Power . . . How much power is installed to produce transportation by the various types and sizes of carriers? This is shown in a general way by Table 6. The column to the extreme right of the table indicates the transportation service produced daily per horsepower.

Fuel consumption . . . Another interesting index is one representing the amount of work required to transport by various methods. If there were a direct way of representing the friction to be overcome by each type, such data would be interesting. Probably much the same end can be attained by looking at the fuel consumption characteristic of each method of transportation.

Such data are presented in Table 7, which highlights the advantage of both larger power plants and larger transportation equipment. The consumption on the empty or ballast leg of the tanker, the integrated river tow, and the transport-truck movement have been taken into account

Load factor . . . Load factor, the relation between average use and peak-period use, is important in a transportation activity subject to substantial swings in demand for service.

Maintaining equipment in an idle or standby position to meet peak demands can be costly. Table 8 shows that there is a considerable spread in the degree of utilization of the various types of transportation.

The use of specialized equipment results in a one-way loaded and a light return movement, except for pipelines. Trucks and tank cars are moving empty almost half the time. Marine equipment from barges to large ocean tankers moves in ballast about half the time.

The development of a limited number of dual-purpose carriers which can load either bulk liquids or bulk minerals exemplifies the ingenuity, imagination, and venturesomeness applied to this problem. The operation of dual-purpose ships on triangular or multilateral routes, spanning much of the globe, should reduce the percentage of annual voyage time is ballast.

The utilization ranges from the fairly flat annual demands placed on the crude-oil trunk pipelines to the highly seasonal demand placed on the transport trucks.

Flexibility in adapting a transportation method to changing demands for its service is another important feature. Marine transportation provides considerable flexibility because ships can be assigned from one route to another. There is less variability in total capacity provided because of operating exigencies that militate against ships in and taking them out of layup.

Pipelines offer little, if any, adaptability insofar as routes are concerned. They are fixed when the line is built. Pipelines do offer an almost infinite variation in quantity of transportation

TABLE 7—FUEL CONSUMPTION

Equipment—	Consumption	
	Oil*	Fuel§
16,000-ton T-2 tanker†	15.3	3.3
30,000-ton tanker†	12.2	2.6
45,000-ton tanker†	10.0	2.1
100,000-ton tanker†	7.0	1.5
70,000-bbl. integrated river tow	17.3	3.9
1,000-mile pipeline:		
8 in. in diameter	19.2	1.4
12 in. in diameter	17.2	1.7
16 in. in diameter	15.0	1.7
24 in. in diameter	9.4	1.3
10,000-gal. railroad tank car‡	36.8	..
6,000-gal. truck tractor semi-trailer	77.5	0.8

*Short tons per million ton-miles of transportation. †Tanker size expressed in long tons, deadweight capacity. ‡Represents a tonnage train. §Percentage of annual short tons carried.

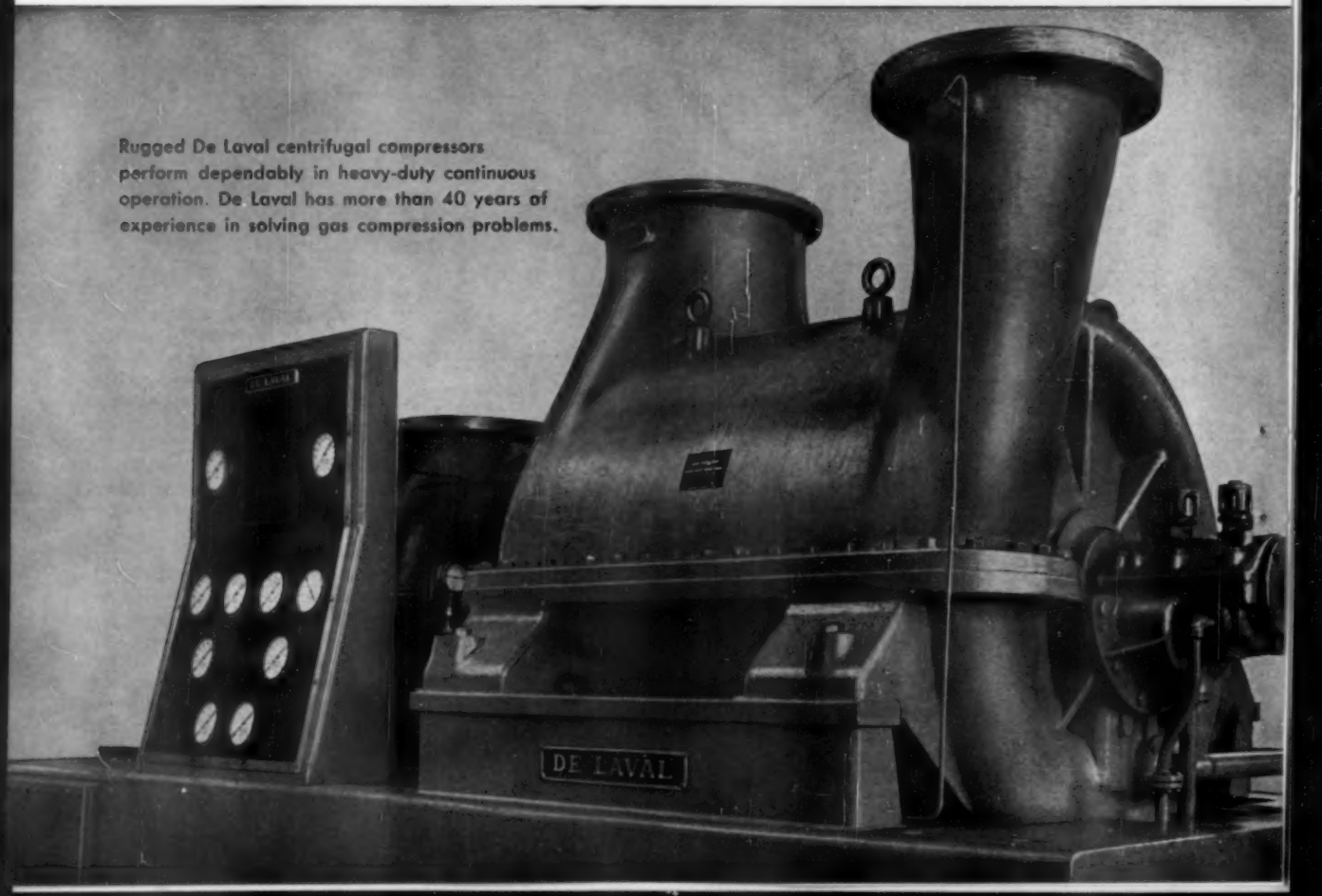
TABLE 8—CHARACTERISTIC ANNUAL LOAD FACTORS

	Range (in per cent)
Ocean tanker	84 to 88
Integrated river tow	90 to 94
Product pipeline	86 to 90
Crude-oil pipeline	95 to 98
Railroad tank car	80 to 84
Transport truck	58 to 62

TABLE 9—REPRESENTATIVE CAPITAL COSTS

Equipment—	Investment (dollars)	Investment* (dollars)
American built:		
16,000-ton. T-2 tanker†	5,750,000	6,060
30,000-ton. tanker†	9,250,000	4,590
45,000-ton. tanker†	13,200,000	4,500
Foreign built:		
30,000-ton tanker†	6,200,000	3,070
45,000-ton tanker†	9,200,000	3,140
100,000-ton tanker†	16,000,000	2,740
70,000-bbl. integrated river tow	1,700,000	6,200
1,000-mile pipeline:		
8 in. in diameter	30,000,000	23,100
12 in. in diameter	40,000,000	10,250
16 in. in diameter	55,000,000	8,450
24 in. in diameter	80,000,000	4,100
10,000-gal.-railroad tank car, general purpose	9,700	46,500
6,000-gal. truck tractor semitrailer	18,000	6,150

*Per million short ton-miles of transportation capacity. †Tanker size expressed in long tons, deadweight capacity.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service provided up to the point of full capacity, because pumping power can be adjusted over a wide range.

The high fixed and continuing costs act as strong deterents to the use of pipelines at less than full capacity. The utilization of railroad transportation can be varied greatly because service is purchased from the rail carriers in increments as required.

The situation is different with the tank cars themselves because they are not provided by the carriers. The shipper either provides his own tank cars or hires them from tank-car companies. These investments are substantial, and it is intended that the owner be repaid by the carrier for his investment.

This reimbursement is through the payment of a mileage allowance by the carrier. This payment should be at rates duly conpensatory to owners,

TABLE 10—FIXED AND VARIABLE COSTS

Method—	Percentage— Fixed	Variable
Ocean tanker	20	80
Integrated river tow	30	70
Product pipeline	75	25
Crude-oil pipeline	65	35
Railroad tank car	5	95
Transport truck	15	85

TABLE 11—REPRESENTATIVE TARIFF RATES

Method and movement—	Tariff in cents per bbl.	Equivalent tariff per short ton (dollars)	Approx. route, in miles	Cost per million short ton-miles (dollars)
Crude-oil pipeline:				
West Texas to Gulf Coast	20	1.35	495	2,730
Mid-Continent to Chicago, Ill.	24	1.62	627	2,580
Rocky Mountains to Chicago, Ill.	36	2.42	1,120	2,160
Alberta to Sarnia, Ont.	64	4.31	1,705	2,530
Product pipeline:				
Mid-Continent to Chicago, Ill.	58	4.48	627	7,100
Baton Rouge, La., to Charlotte, N. C.	35	2.71	715	3,800
New York Harbor to Buffalo, N. Y.	34.8	2.69	380	7,100
	In dollars per long ton			
Ocean tanker:				
Gulf Coast to Philadelphia Harbor	2.85	2.54	*2,120	1,245
River tow:	In mills per short ton-mile			
Houston, Tex., to upper Ohio and Mississippi rivers	2.10	4.20	2,000	2,100
	In cents per gal.			
Transport truck:				
Distance scale, East Coast	6.89	22.40	400	56,000
	3.06	9.86	200	49,300
	1.45	4.67	100	46,700
	0.79	2.55	50	51,000
	In dollars per cwt.			
Railroad tank car:				
Philadelphia, Pa., to Palatka, Fla.	1.40	29.85	958	31,200
Philadelphia, Pa., to Zanesville, Ohio	0.80	17.05	501	34,100
Philadelphia, Pa., to Pittsfield, Mass.	0.64	13.50	260	51,900
Philadelphia, Pa., to Harrisburg, Pa.	0.34	7.22	103	70,000

*Statute miles.

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This compressor operates at an inlet pressure of 14.3 psia and a discharge pressure of 42.8 psia. The power required is 1860 bhp with the compressor operating at 5400 rpm.

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based on their investment in tank cars which are reasonably adequate to perform an annual transportation service.

Terminal facilities . . . A preference for one transportation method or another cannot be based solely on in-transit or line-haul considerations. This has been emphasized most recently by the industry's increased use of larger ocean tankers. The terminal at origin and destination must be appropriate to the transportation equipment.

This may mean substantial modifications to volumes of tankage, size of loading and receiving lines, and for marine equipment, wharves, mooring facilities, and waterways. This spells additional investment in plant. Probably, ocean tankers place the heaviest demands on terminal facilities.

Pipelines also impose characteristic terminal requirements which result from the rates of flow, frequency of cycles or batches, and location of a terminal as intermediate at a principal junction point or at the end of the line.

Trucks are at the other extreme, placing minimum demands on terminal facilities, but here also careful attention should be given to size lines, number of loading spots, and hours of operation.

Inventories . . . The inventories typical of the various transportation methods are markedly different both as to in-transit stocks and terminal stocks. Although the matter of where to obtain crude oil or product for inventory has not been a problem in the recent past, the financial aspect of inventories does have considerable impact.

As the size of the individual delivery increases and the frequency of delivery decreases, there is an increase in average inventories at terminals. This exposes increased quantities of oil to the hazard of loss, as well as placing increasing strains on working capital. Less frequent delivery can aggravate the problem or maintaining product quality.

With increased speed, certainty, and frequency of delivery, it is entirely possible to decrease inventories. This is one of the advantages which the transport truck has had to offer because the old-time bulk plant has frequently been bypassed completely.

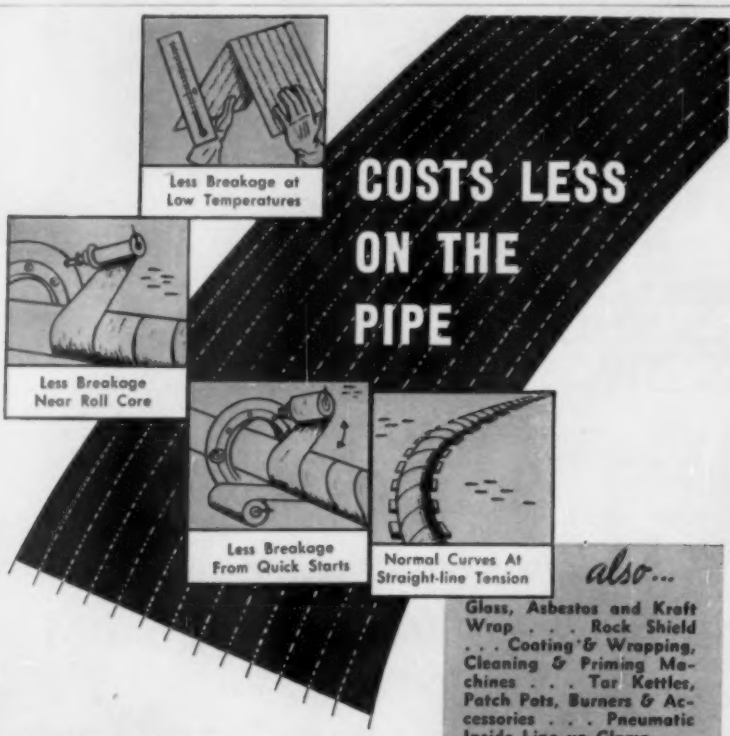
Costs . . . To the maximum extent possible, our everyday commercial decisions have to be reduced to monetary terms. It is here that we reflect our composite evaluation. There is little basis for any generalized comments on transportation costs.

Costs have to be derived from a specific application to be meaningful; otherwise they may lead to harmful impressions and misinterpretations. The more important types of cost include: (1) original costs, representing the initial investment in transportation facilities; (2) fixed and variable costs; and (3) market costs as represented by tariffs on pipelines, trucks, and railroads, and voyage and time-charter rates for tankers.

Original costs range from huge capital costs for a large pipeline system or a large tanker to the purchaseing of service on a for-hire basis with its avoidance of capital investment by the shipper. See Table 9.

The relative importance of fixed costs and variable costs differ widely among the transportation methods. Table 10 is indicative of such costs for the various methods. With the important exception of the oil pipelines, petroleum carriers' expenses are largely variable in nature, i.e., they vary, in general, as volume varies.

Market costs are represented by the tariffs of the common-carrier pipelines, of the for-hire transport truckers, of the railroads, and by the market rate for tankers. Some rates are presented in Table 11.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A 20-year goal is reached

Knock Ratings Now Predictable

Work should lead to better understanding of combustion, which is the reaction that consumes more than 90 per cent of petroleum

By L. C. Beard, Jr.

AFTER 19 YEARS of hard work, it is now possible to estimate with reasonable accuracy the knock rating of a pure hydrocarbon if the chemical structure be known.

Earlier work on binary blends of pure hydrocarbons indicated that many such blends were synergistic by the research method, although frequently antagonistic by the motor method. Subsequent work with matched blends shows more synergism, although the motor method usually decreases synergism and increases antagonism.

Matched blends of hydrocarbons of the same type give knock ratings which are approximately linear with composition. In general, blends of different types of hydrocarbons show synergism, which is accentuated by the presence of TEL.

This may be due to the fact that TEL raises the octane level. As many as 25 performance numbers have been observed. Synergism is also favored by high octane levels, the research method, and paraffins as one of the blend components.

Dicyclopentadiene causes clear blends to be antagonistic. When TEL is added, the blends with paraffins are still antagonistic when the cyclopentadiene content is greater than 12 per cent. Below this concentration the blend becomes synergistic peaking to a minimum around 3 per cent.

Additional data—just available at the time this paper was written, and presently under study by the project committee—amplify and, to some extent, complicate the foregoing general conclusions. These data, based on a preliminary study, indicate that blends of naphthenes and paraffins are generally linear or synergistic. Olefins, in nearly all blends with paraffins, are synergistic; with naphthenes, either linear or synergistic.

Aromatics conform presently to no general pattern, but xylenes blended with paraffins are particularly antagonistic. However, the addition of olefins to paraffin-aromatic blends makes them linear or synergistic.

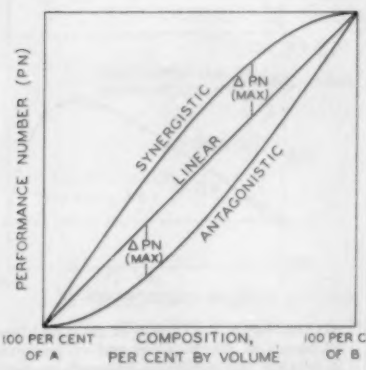
Nearly all blends containing diolefins are antagonistic.

Empirical correlations . . . Knock-rating data have, on several occasions, been the subject of logical empirical correlations with the chemical structure of the hydrocarbons. Over the years, these correlations have been improved. By 1956 Research Project 45 Advisory Committee felt that, by their use, the knock ratings of pure hydrocarbons could be predicted with reasonable accuracy if their chemical structure were known, and that it would be unrewarding to synthesize additional hydrocarbons with knock measurement as a major objective.

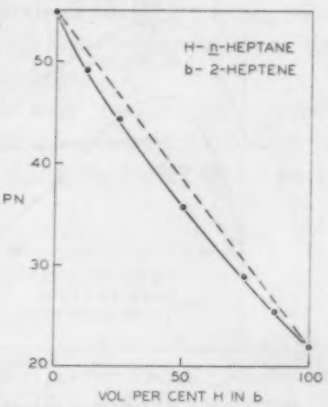
This represents the achievement of a goal hoped for 20 years ago. Since these correlations have been adequately recorded in the technical literature,[2,3,4] it is unnecessary to repeat them here.

It does seem appropriate, though, to recall the tremendous influence which chemical structure has on knock rating by citing a few simple examples of hydrocarbons having seven carbon atoms. Comparison of the two paraffins, n-heptane and triptane, which have exactly the same

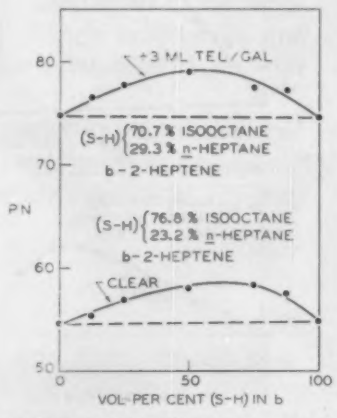
Author is with Socony Mobil Oil Co., Inc., New York. Paper presented at A.P.I. annual meeting, Chicago, under the original title, "Fundamental Research on the Antiknock Properties of Pure Hydrocarbons and Their Blends."



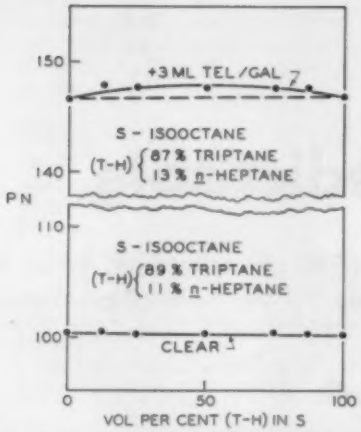
TYPES of blending curves. Fig. 1.



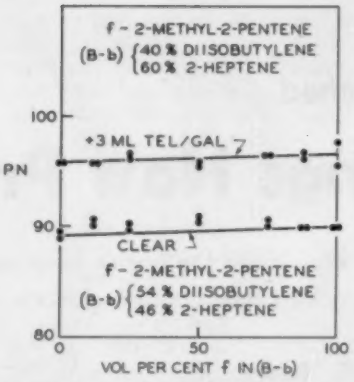
ANTIKNOCK RATINGS of blends of 2-heptene and n-heptane. Fig. 2.



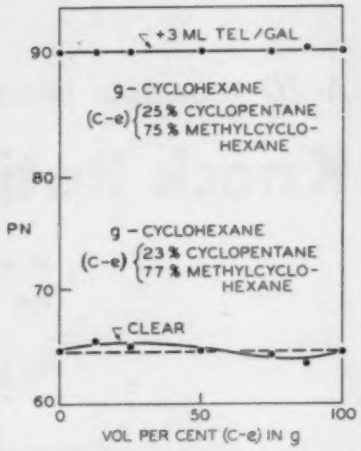
ANTIKNOCK RATINGS of clear and leaded blends of 2-heptene in isooctane and n-heptane. Fig. 3.



ANTIKNOCK RATINGS of clear and leaded blends of isooctane in triptane and n-heptane (research method). Fig. 4.



ANTIKNOCK RATINGS of clear and leaded blends of 2-methyl-2-pentene in diisobutylene and 2-heptene (research method). Fig. 5.



ANTIKNOCK RATINGS of clear and leaded blends of cyclohexane in cyclopentane and methylcyclohexane (research method). Fig. 6.

number of carbon and hydrogen atoms, shows that branching of the hydrocarbon chain has raised knock rating enormously. Abstracting two hydrogen atoms near the middle of the n-heptane chain to form 3-heptene more than triples the knock rating.

Tying the n-heptane into a methylcyclo ring more than doubles the performance number. Finally, abstracting six hydrogens from the methylcyclohexane to give us toluene nets us the highest performance number of all—although some may quarrel with the performance number given to toluene because of the difficulty of rating aromatics.

Regardless of this, the fact remains that the conversion of cyclic paraffins to aromatics is the principal reason reforming is so effective in raising knock rating.

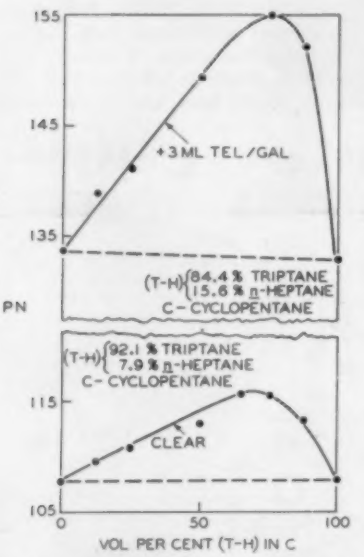
This is an oversimplification of only a few of the broader generalizations which have developed from the correlative work of Project 45. There are many refineries, for which reference should be made to the reports on the project and the technical literature.

It is planned for the near future, in collaboration with the American Society for Testing Materials, to bring all these knock-rating data together in book form so that they may be readily available in a single publication.

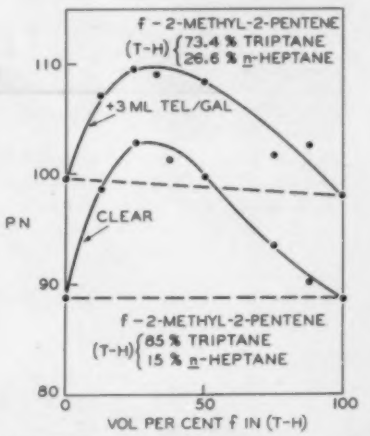
It is strongly suspected that the nature of the preflame-oxidation reactions which occur during the compression stroke has an important influence on the subsequent combustion.

As much as 50 per cent of the fuel can be preoxidized before the spark passes.[5] So what the engine actually consumes by spark-initiated combustion is not necessarily the fuel which was put into the tank. Studies on the mechanism of combustion, catalyzed by the work of Project 45 and now sponsored by the Air Force Office of Research and Development, are under way at Ohio State University[6,7,8] and elsewhere.

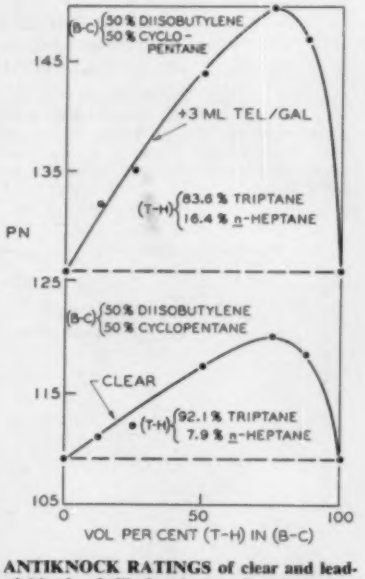
It became obvious to those associated with the project that the "blending value" of a hydrocarbon depended not only upon the concentration at which the measurement was made, but also upon the base fuel. Consequently, in order to evaluate the true utility of a hydrocarbon component of a gasoline, it became necessary to work out some of the



ANTIKNOCK RATINGS of clear and leaded blends of cyclopentane in triptane and n-heptane (research method). Fig. 7.



ANTIKNOCK RATINGS of clear and leaded blends of 2-methyl-2-pentene in triptane and n-heptane (research method). Fig. 8.



ANTIKNOCK RATINGS of clear and leaded blends of diisobutylene and cyclopentane in triptane and n-heptane (research method). Fig. 9.

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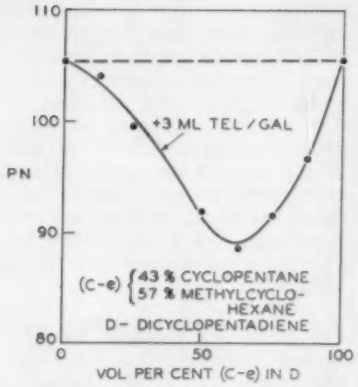
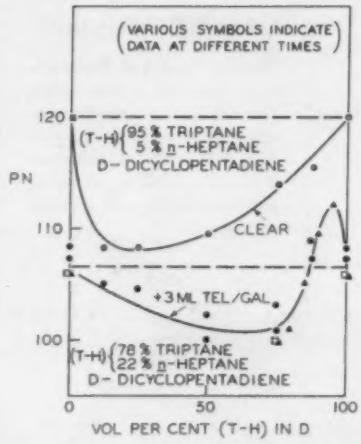


ANTIKNOCK RATINGS of leaded blends of dicyclopentadiene in cyclopentane and methylcyclohexane (research method). Fig. 10.



ANTIKNOCK RATINGS of clear and leaded blends of dicyclopentadiene in triptane and n-heptane (research method). Fig. 11.

fundamental relationships of even such simple things as two-component blends.

Ethyl Corp., through its member on the advisory committee, contributed a large amount of data[9] to the project as a way of getting started on an important new objective. These data showed three types of blending curves, as illustrated in Fig. 1, namely, linear, synergistic, and antagonistic. Table I taken from the Ethyl Corp. report, summarizes this large volume of data. It will be noted most of the blends were synergistic when the research method was used but were antagonistic by the motor method.

Matched Blends

Suppose it is desired to know the blending characteristics of the olefin, 2-heptene, in a paraffinic hydrocarbon. You could blend the 2-heptene with n-heptane, or with isooctane, or with a mixture of n-heptane and isooctane which would have the same performance number as 2-heptene alone. This last is a "matched blend." Figs. 2 and 3 illustrate this. In Fig. 2 the blend is slightly antagonistic, but in Fig. 3 the matched blends are synergistic to the extent of several performance numbers.

This idea of matched blends has been the major basis for the work over the past 2 years. During this period, several thousand octane-number determinations were made, under most carefully controlled conditions. The results of this work have been reported by Blanding[10] and by Scott,[11] and what follows here is largely a condensation of their reports.

Knock-test data . . . Interaction is minimal in blends consisting of hydrocarbons of the same class, as shown in Fig. 4. This same absence of interaction is shown in Fig. 5 for blends of an olefin in an olefin mixture—specifically, 2-methyl-2-pentene in a matched blend of diisobutylene and 2-heptene.

Little or no interaction is evidenced in Fig. 6 for blends of naphthenes—in this case, cyclohexane in a matched mixture of cyclopentane and methylcyclohexane.

It will be noted that no data are given for blends of aromatics in aromatics. This is because present knock-test methods give inconsistent results when applied to fuels of high aromatic content. This matter is receiving attention by the A.S.T.M. and the Coordinating Research Council.

Things would be very simple if we were concerned only with blends of paraffins in paraffins, olefins in olefins, and naphthenes in naphthenes. Let us see now what happens when we blend different classes of hydrocarbons together. In Fig. 7 we see what happens when the naphthene, cyclopentane is blended with a mixture of the paraffins, triptane and n-heptane. A synergistic effect of some 8 performance numbers is shown in the clear blends by the research method, which increases to about 22 when TEL is present. The motor-method data show the same synergism, but to a somewhat lesser extent. Particular attention is directed to the way in which TEL increases the synergism. It seems to be fairly general that if the clear blends show synergism, TEL will increase it.

Fig. 8 (research) shows strong synergism when an olefin (2-methyl-2-pentene) is blended into a matched mixture of paraffins (triptane and n-heptane). When diisobutylene is blended into a matched mixture of triptane and n-heptane. The research ratings show strong synergism, and again TEL enhances the synergism of the clear blends.

In Fig. 9 a 50-50 mixture of diisobutylene and cyclopentane is blended into a matched mixture (research) of triptane and n-heptane. It will be observed that the blends containing TEL show a synergism of about 25 performance numbers, or about 8 octane numbers.

Where blending an aromatic (ethylbenzene) into a research method matched blend of triptane and n-heptane, a synergism of five performance numbers occurs in the clear blends, which is multiplied fourfold by the addition of TEL.

All of the blends dealt with up to this point have shown either synergism or no interaction. Now, in Fig. 10, is exhibited a case of antagonism. The matched blend is dicyclopentadiene in a mixture of cyclopentane and methylcyclohexane and it contains TEL. This antagonism is also shown when dicyclopentadiene is blended into a mixture of diisobutylene and 2-heptene, also containing TEL.

Finally, Fig. 11 really confuses matters. This shows research ratings on a blend of dicyclopentadiene in a matched mixture of triptane and n-heptane, both clear and with TEL. The clear curve shows the antagonism characteristic of blends containing

TABLE I SUMMARY OF EARLY ETHYL CORP. DATA ON HYDROCARBON BLENDS

Compounds blended—	Average of Maximum Deviation From Linear Octane Number, Expressed as PN			
	Motor Method TEL ML/Gal.		Research Method TEL ML/Gal.	
Paraffins in Paraffins	2.47	7.90	2.91	10.56
Paraffins in Naphthenes	—1.99	1.92	2.76	8.16
Naphthenes in Naphthenes	3.32	3.33	8.53	9.35
Paraffins in Olefins	1.76	— 1.23	8.25	6.55
Naphthenes in Olefins	0.64	— 1.47	7.33	6.67
Naphthenes in Aromatics	—11.84	—14.10	4.26	12.72
Paraffins in Aromatics	— 4.63	— 9.08	6.90	9.83
Olefins in Olefins	— 0.09	— 0.67	3.67	2.18
Olefins in Aromatics	— 5.60	— 6.90	5.70	4.44
Aromatics in Aromatics	— 3.94	— 3.42	0.82	0.62

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cyclopentadiene. The blends containing TEL show the negative response to TEL which has been known for some time. Also, antagonism is shown up to the point where the blend contains about 12 per cent of dicyclopentadiene and then synergism takes over, peaking to a maximum of about seven performance numbers at a dicyclopentadiene content of about 3 per cent. This is real and has been confirmed independently in two laboratories.

The future . . . Examples have been cited of increases of as much as 25 performance numbers (roughly 8 octane numbers at the 98-octane-number level). Since increases in octane number are becoming increasingly difficult to achieve, industry may well find useful employment of these data as they are expanded and better understood.

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Domestic Reserves and the need for an Excess Producing Capacity for security

Imports plan should encourage drilling here at home; but we must also consider how to obtain greater recoveries of oil actually in place in the ground

By Ernest O. Thompson
Texas Railroad Commission

THE ADVANCE in technique of conservation of reservoir pressure and the control of this pressure constantly increases our percentage of recovery from oil reservoirs.

Since oil was discovered in the United States in 1859 by Colonel Drake, we have produced 55.2 billion barrels of oil. Our reserves on hand as of January 1, 1957, are 30.4 billion barrels. In order to produce these 55.2 billion barrels of oil and build up this 30-billion-barrel reserve in known producing fields, we have had to drill 1,600,000 oil wells.

We produce in the United States around 7 million barrels of crude oil per day, and in addition about a half million barrels of naturals, distillates, and condensates. The National Petroleum Council recently reported that our daily reserve producing ability from present wells was a little over 3 million barrels per day. It is predicted that our domestic demand for petroleum products will be around 13 million barrels per day in 1965. This will be a gain of 46 per cent over our demand of 8,750,000 bbl. in 1956.

In 1946 we found 1 million barrels of oil for each 35,000 ft. of hole drilled. In the year 1956 it took 75,000 ft. of hole to find 1 million barrels of oil. These wells are constantly deeper and, therefore, the cost is greater by far.

The present gas reserves in the United States are 328 trillion cubic feet. Most of these natural-gas reserves have been found as an incident to the intentional search for oil. But the great expansion in demand for natural gas has become such that we will, if necessary, have to make a most thorough search for natural-gas production on purpose and independent of the search for oil. This is emphatically demonstrated by the search for and success in finding natural-gas reserves for our very great industrial expansion along the Gulf Coast of Texas. I have only to cite Dow Chemical, Union Carbide, and Alcoa; and I could point to many others who have come to Texas to get dependable natural-gas reserves sufficient to supply their plants for the forseeable future.

Paper presented at annual A.P.I. meeting, Chicago, under the original title, "Domestic Reserves and the Need for an Excess Producing Capacity for National Security."

Drilling slump . . . In 1957 drilling has fallen behind about 10 per cent below 1956 in the number of wells. This decrease in number of wells drilled can be traced somewhat to wider spacing and unitization, but the greater decrease is due to the supplanting of domestic crude by excessive oil and products imports into this country. Then, too, the interst rates on borrowed money have mounted. Also, money is harder to borrow.

Then, too, there is that little matter of what the bankers call "compensating balance" now generally required which, of course, means you actually leave on deposit and never use about 20 per cent of what you think you are borrowing, which really adds to the interest rate on the money you are actually allowed to spend on the drilling of new wells.

As to the imports problem, Section 7 of the Reciprocal Trade Act sets out a directive to the President of the United States as to what he has to do and how he is to do the job to remedy the situation whenever any commodity is being imported into the United States in such quantities as to threaten to imperil the national security.

The Office of Defense Mobilization has certified that such a condition now exists as to oil imports. The President then appointed a cabinet special-study committee to check on the report of ODM. This committee made a report which definitely confirmed the findings of ODM and suggested a voluntary reduction plan which the President approved and which is now in effect.

Import plan . . . Capt. Matthew V. Carson was named the administrator of the voluntary plan to restrict imports. He promptly held hearings for the purpose of consideration of applications and objections under the plan, and has acted upon these cases promptly and, I believe, to the satisfaction of the domestic producers.

It now appears that the plan will be observed by the importers, and that relief will be had from these excessive imports. If this works out, it should tend to encourage drilling here at home and help to keep the United States from becoming increasingly dependent upon foreign crude oil for our national security and our ever-expanding economy. In an unsettled and troubled world, we must be as careful as possible to assure adequate gas and oil reserves for our defense. These reserves can be kept on a safe basis only by insuring the maintenance of a virile, prosperous domestic oil-producing industry.

I think it well to point out that by 1965 we will have to drill some 645,000 additional oil wells if we are to keep our reserves in the same proportion to demand as they are today. The country's energy consumption is growing at the rate of a little less than 3 per cent a year.

The Suez closing demonstrated what would happen should war come. The way to prevent war, we are told, is to be prepared; and certainly a war cannot be fought these days without adequate oil supply.

I have talked with a number of senators since the recess of Congress, and I feel sure there will be repercussions over the renewal of the Trade Act unless the suggested remedial curtailment of imports is observed. Many senators from oil-producing states depended absolutely upon the assurances that Section 7, Subsection b, of the Trade Act would be implicitly

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followed out as directed. Such assurances were given on the floor of the Senate almost 2 years ago.

The Trade Act expires in June 1958, and I am hopeful that the performance under the voluntary curtailment plan will be so successful and so rigorously followed out that there will be no discontent.

I have every confidence in the seriousness of our President in carrying out this program, and I am most grateful and gratified over the action and promptness of Captain Carson, who is so ably and vigorously administering this plan.

Estimated Additional Recovery of Oil

In addition to exploration for new reserves, we must consider the concept of obtaining greater recoveries of oil actually in place in the ground. In years past the primary recovery of oil has resulted in from 50 to 85 per cent of the oil in place being left in the ground. Modern techniques, however, have increased the recoveries to far in excess of 50 per cent.

This has been accomplished by the injection of extraneous fluids in order to maintain reservoir pressure, aiding in the movement of fluids from the reservoir to the well bore. These processes may be identified as water flooding, cycling, gas injection, and a newer technique of miscible fluid displacement. This latter process, we have been told by the research people, can very nearly approach 100 per cent recovery of oil in place, and has so been demonstrated in the laboratory.

We have several of these projects now going on in Texas, but as yet we are unable to ascertain the degree of success because of insufficient history. These additional recovery techniques simply mean that we can expect to actually recover more oil in the future from reserves comparable to those discovered in the past. The Railroad Commission holds hearings on application of various operators to carry on these fluid-injection projects. During the years 1956 and 1957, we have been told in these hearings that the additional recovery over primary recovery, as a result of these operations, will amount to approximately 300,000,000 barrels.

While we are discussing oil reserves for defense, I think we should take a look at our principal oil-producing neighbors in the Western Hemisphere.

CANADA[1]

Existence of major undiscovered crude reserves and availability of prospective acreage are two of the important factors comprising the current Canadian oil situation, which is beckoning the interest of the oil industry in general.

Exploration operations in Canada are still in their infancy. Recent and important discoveries in Canada are as follows:

1. Devonian D-3 oil discovery in the Innisfail area in June, 1957, by Canadian oil companies and their partners.

2. Slave Point oil discovery in the Virginia-Swan Hills area by Home Oil Co., Ltd., and its partners.

3. Wet-gas discoveries in the Waterton area foothills by Shell Oil and Texaco Oil companies in 1956.

4. Devonian Reef gas discoveries at Rabbit Lake in the southern part of the Northwest Territories.

5. Granite Wash discovery in the Peace River Arch area.

Drilling operations in western Canada have climbed sharply in recent years and another new peak is anticipated in 1957. For example, in 1955 a total of 3,162 wells were drilled in Canada. In 1956, 3,760 wells were drilled; and it is forecast that some 4,075 wells will be drilled during 1957.

VENEZUELA

Daily average production in Venezuela, the world's second largest producer, was 2,456,785 bbl. daily, 300,000 bbl. higher than the volume produced in 1955. An average of 2,850,000 bbl. daily is expected for 1957.

Prospects for increased development indicate that Venezuela's production of oil is likely to continue to expand in coming years. The granting of the first new oil concessions in the country since 1945 will undoubtedly result in the discovery of additional major oil reserves.

Despite steadily increasing producing rates, Venezuela's proved crude and natural-gas reserves continued growing to new all-time peaks.

Proved unproduced reserves of crude oil in Venezuela were estimated at nearly 14 billion barrels at the end of 1956. This represented a net increase of 1½ billion barrels during the year, although the producing rate was much higher than ever before. Since 1950, a total of 9½ billion barrels of new oil have been found in Venezuela, a volume slightly larger than the country's proved reserves at the end of 1950. This discovery rate was more than double the producing rate. The net addition to proved reserves has totaled nearly 5¼ billion barrels since 1950.

The greatest hope for greater oil recovery lies in the advance in the study of reservoir control.

Reference

1. World Oil, Special Report Canada, Aug. 15 (1957).

CANADIAN CRUDE-OIL RESERVES FOR 1954, 1955, AND 1956 BY PROVINCES
(In thousands of barrels)

Province—	Reserves as of Dec. 31, 1956	Reserves as of Dec. 31, 1955	Reserves as of Dec. 31, 1954
Northwest Territories	53,258	53,707	26,172
Alberta and British Columbia	2,391,778	2,169,985	1,928,479
Saskatchewan	358,693	236,872	222,365
Manitoba	42,005	45,211	29,127
Ontario and New Brunswick	3,636	3,759	1,471
Total	2,849,370	2,509,534	2,207,614

TOTAL WELLS DRILLED, UNITED STATES

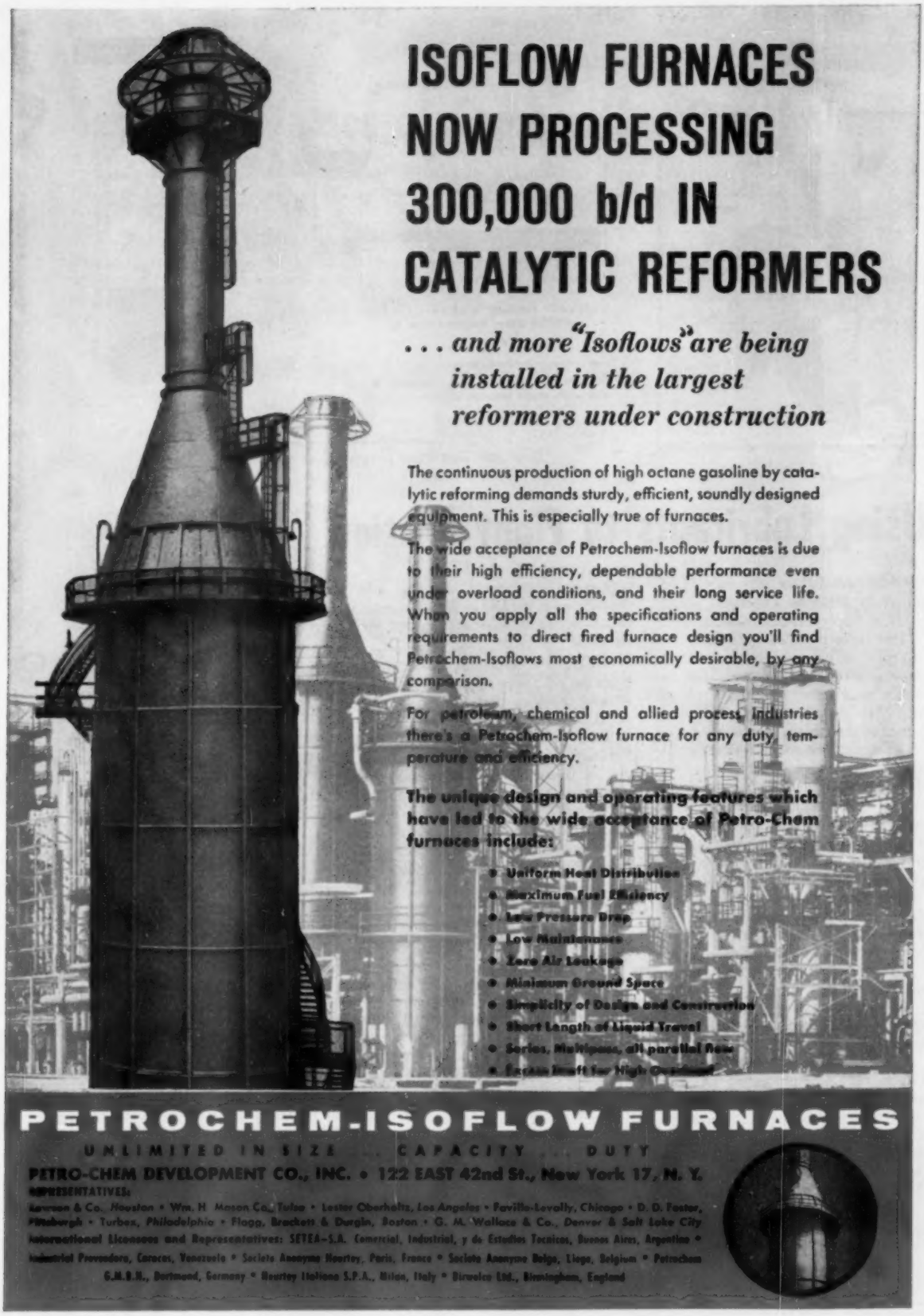
Year—	Wildcat wells	Total wells
1951	10,302	44,516
1952	10,552	45,821
1953	11,062	49,279
1954	11,280	53,930
1955	12,271	56,682
1956	13,034	58,160
1957*	12,700	55,434

*Last half estimated. Source: The Oil and Gas Journal, 131, July 29 (1957).

VENEZUELA'S PROVED RESERVES OF OIL AND NATURAL GAS

	Oil		Natural gas	
	Millions of barrels	Ratio prod. to reserves	Billions of cu. ft.	Ratio prod. to reserves
Dec. 31, 1949	8,215	5.8	.....	.....
Dec. 31, 1950	8,724	6.3	16,904	3.20
Dec. 31, 1951	9,063	6.9	16,933	3.87
Dec. 31, 1952	9,428	7.2	17,212	4.03
Dec. 31, 1953	10,152	6.9	19,353	3.48
Dec. 31, 1954	10,919	6.3	21,019	3.27
Dec. 31, 1955	12,429	6.3	23,304	3.06
Dec. 31, 1956*	13,951	6.4	26,950	2.97

*Estimate.



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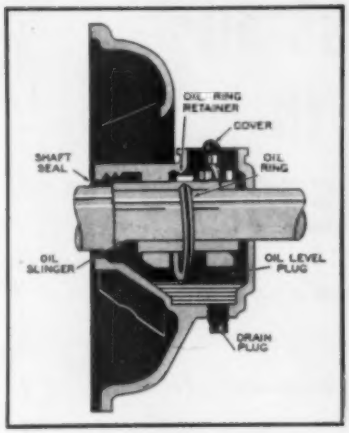

Fig. 1

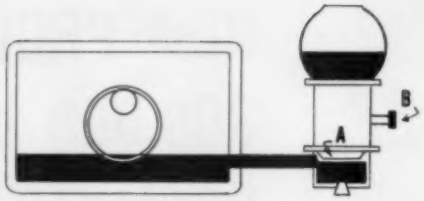

Fig. 2

Optomatic constant level oiler. Oil flows from point A. To refill oiler, loosen screw B.

Section of ring-oiled plain bearing. Rings dip with shaft into an oil reservoir.

Gage glass used where reservoir must be checked regularly.

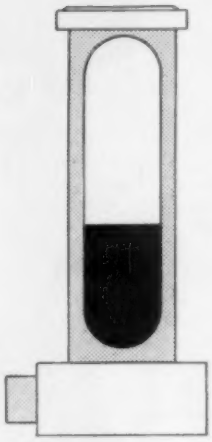

Fig. 3

Using Lubricants to Fight Friction

WHEN two surfaces are rubbed together, a force is generated which tends to oppose this motion.

This force is called friction.

From past experience we know there is more friction generated between rough surfaces than smooth ones. However, no matter how well a part is machined, if it were placed under a microscope we would be able to see tiny ridges and crevices on the surface. When two of these machined surfaces are rubbed against each other, the ridges of one part overlap the crevices of the other—similar to the action of a pair of gears.

This action causes wear and produces heat which increases the frictional force between the two surfaces, thereby producing more wear.

Something is needed to keep the surfaces apart.

Lubrication serves this purpose by forming a film between the two surfaces.

Lubricants . . . Lubricating oils normally are in the liquid form at equipment - operating temperatures. Therefore, oil carries off heat from the bearing surfaces much better than grease. This is the principal reason for using oil lubrication for high-speed equipment. Another advantage of using oil is the ease with which it can be checked, added, or changed.

Grease is a semisolid which combines an oil and a soap. In the past, it was thought that the soap just acted as a storehouse for the oil and did not assist in the lubrication. Pressure was supposed to squeeze out the oil which then lubricated the bearing surface. This has been found to be only partly true. Tests have shown the soap is absorbed by the metal and levels out the bearing surfaces. Therefore, although some of the oil is forced out of the soap, most of it stays in place and along with the soap it provides the film which reduces the friction between the surfaces.

One of the principal advantages of using a high-quality grease for lubrication is that water will not displace it in the bearing. The principal disadvantage in its use is that there is a tendency to put too much grease in a bearing housing.

If the housing is more than half full when the machine is stopped, the churning and expansion of the grease will cause the bearing to overheat and fail.

All rotating equipment is fitted with some type of bearing to allow the shaft to turn with a minimum of friction. The three general types are radial, thrust, and guide bearings. The radial bearing is designed to support the load of the shaft and the rest of the rotating assembly. The thrust bearing is designed to resist the force which acts along the shaft. The guide bearing may or may not support a load. Its main purpose is to keep the shaft from flexing or bending.

Radial and thrust bearings may either be of the sleeve, ball, or roller type. Guide bearings usually are of the sleeve type. Horizontal centrifugal pumps usually have one radial bearing and one thrust bearing. Vertical centrifugal pumps with long shafts have guide bearings placed at various intervals along the shaft and the motor is fitted with a thrust bearing.

Pump lubrication . . . The majority of modern horizontal centrifugal pumps are oil lubricated.

The most common method of lubricating them is through the use of an oil ring which rides freely on the pump shaft. (See Fig. 1). As the shaft turns, the ring dips into the oil in the reservoir and carries it to the bearing.

Usually an oil (see Fig. 2) is used to keep the oil in the equipment reservoir at the proper level.

This material taken from process-training-program manual, Baton Rouge, La., refinery of Esso-Standard Oil Co.

By W. L. Nelson
Technical Editor

Questions on TECHNOLOGY

Tabulated Values of Construction Cost Index

Can you please give me the quarterly or monthly values of your Nelson Construction Cost Index starting with 1948? J.B.

Although yearly values of the Nelson Index have been computed back to 1926, monthly values start in September 1949. Tabulated values of the material and labor components used in computing the Nelson Index are shown on this page as well as the index for Miscellaneous Equipment which is used only in computing the labor component.

The Nelson Index has been discussed in the following issues of The Oil and Gas Journal:

December 15, 1949—A Refinery Cost Index.

October 1, 1956—How the Nelson Refinery Construction Cost Index Is Computed.

August 5, 1957—Construction Costs.

Nelson Refinery Construction Cost Index (Since 1926)

Year or date—	Materials Component	Labor Component	Misc. Equipment†	Nelson Index
1926	87.7	61.5	94.0	72.0
1928	93.2	64.5	89.0	71.0
1929	83.2	64.5	87.0	72.0
1930	76.0	66.5	84.0	70.3
1931	72.2	60.0	82.0	64.9
1932	68.0	49.0	79.0	56.6
1933	68.3	49.0	76.0	56.7
1934	73.5	55.5	74.0	62.7
1935	74.3	55.0	76.0	62.7
1936	78.2	60.0	77.0	67.3
1937	86.7	66.5	80.0	74.6
1938	84.7	71.5	81.0	76.8
1939	82.0	73.0	82.0	76.6
1940	82.2	74.5	83.0	77.6
1941	84.5	77.0	84.0	80.0
1942	86.2	82.0	85.0	83.7
1943	86.7	86.5	86.0	86.6
1944	87.6	88.5	88.0	88.1
1945	89.7	90.0	90.0	89.9
1946	100.0	100.0	100.0	100.0
1947	122.4	113.5	114.2	117.0
1948	139.5	128.0	122.1	132.5
1949	143.6	137.1	121.6	139.7
September 1949	143.0	139.5	125.1	140.9
October	142.3	140.0	124.8	140.9
November	142.5	140.0	125.3	141.0
December	142.6	140.0	120.3	140.9
January 1950	143.9	140.3	121.0	141.6
February	145.2	140.3	121.8	142.3
March	145.7	140.5	123.1	142.6
April	145.3	141.0	120.6	142.7
May	145.7	142.1	120.6	143.5
June	146.8	143.9	120.9	145.1
July	148.0	144.5	122.1	145.9
August	150.9	146.1	130.1	148.0
September	153.2	146.4	132.4	149.1
October	153.7	147.1	132.4	149.7
November	153.8	147.6	132.8	150.1
December	161.8	147.8	143.8	153.4
1950 year	149.5	144.0	126.2	146.2
January 1951	163.8	148.9	143.5	154.9
February	164.4	149.7	144.2	155.6
March	164.4	150.0	145.2	155.8
April	164.4	150.0	145.2	155.8
May	164.5	150.9	145.2	156.3
June	164.2	151.7	145.2	156.7
July	163.9	153.5	145.2	157.7
August	163.7	154.3	145.2	158.1
September	163.8	154.3	145.2	158.1
October	163.9	155.1	145.2	158.6
November	164.1	155.4	145.2	158.9
December	164.0	156.5	145.2	159.5
1951 year	164.0	152.5	145.0	157.2
January 1952	‡162.7	156.7	145.2	‡159.1
February	162.9	156.9	145.2	159.3
March	161.6	157.5	145.2	159.1
April	§162.8	158.3	§152.1	§160.1
May	162.3	159.5	152.0	160.6
June	162.5	160.5	151.8	161.3
July	162.7	164.1	152.9	163.5
August	166.3	166.9	152.9	166.7
September	167.0	168.0	154.1	167.6
October	167.1	169.1	153.9	168.3
November	166.9	169.5	154.0	168.5
December	167.0	169.7	154.2	168.6
1952 year	164.3	163.1	153.1	163.6
January 1953	167.1	169.7	154.2	168.7
February	167.4	169.8	154.3	168.8
March	167.8	170.0	155.0	169.1
April	168.5	170.2	155.8	169.5
May	169.7	170.4	156.4	170.1
June	171.6	172.4	157.4	172.1
July	176.6	174.7	160.3	175.5
August	177.4	178.0	162.0	177.8
September	176.5	178.4	162.6	177.6
October	175.5	178.9	162.0	177.5
November	175.8	179.0	162.6	177.7
December	175.1	179.3	162.3	177.6
1953 year	172.4	174.2	158.8	173.5
January 1954	174.4	180.0	161.9	177.8
February	173.6	180.0	162.1	177.4
March	172.0	180.2	161.5	176.9
April	173.6	180.3	161.4	177.6
May	173.6	181.5	161.3	178.4
June	173.6	183.0	161.3	179.2
July	175.0	184.0	159.4	180.4
August	175.2	184.7	159.4	180.9
September	175.8	185.6	159.4	181.7
October	176.6	186.1	159.4	182.1
November	176.0	186.3	160.3	182.2
December	174.3	186.4	160.3	181.6
1954 year	174.6	183.3	160.7	179.8
January 1955	‡173.3	186.4	157.3	‡181.2
February	172.1	186.2	157.6	180.6
March	171.1	186.4	158.0	180.3
April	171.3	186.6	158.3	180.5
May	170.9	188.3	158.4	181.3
June	171.2	189.3	159.4	182.1
July	177.8	190.3	160.0	185.3
August	179.2	191.6	161.0	186.6
September	180.7	191.9	165.4	187.4
October	181.5	192.6	166.9	188.2
November	181.6	192.7	167.9	188.3
December	182.6	192.7	167.9	188.7
1955 year	176.1	189.6	161.5	184.2

(Continued on next page)

Nelson Refinery Construction Cost Index (Continued)

Year or date—	Materials Component	Labor Component	Misc. Equipment†	Nelson Index
January 1956	184.7	193.6	168.1	190.0
February	186.2	194.4	175.8	191.1
March	186.5	194.4	175.9	191.2
April	188.5	194.9	177.4	192.3
May	188.5	196.8	178.5	193.5
June	187.7	198.4	179.3	194.1
July	188.8	200.0	181.7	195.5
August	¶195.7	200.9	¶183.0	¶198.8
September	197.4	201.0	183.5	199.6
October	196.9	201.2	185.4	199.4
November	197.5	201.5	186.6	199.9
December	198.1	201.5	188.6	200.1
1956 year	190.4	198.2	180.5	195.3
January 1957	199.0	203.1	188.7	201.5
February	199.0	203.5	189.1	201.7
March	199.1	203.6	189.1	201.8
April	198.9	204.0	192.0	202.0
May	199.8	206.1	192.0	203.6
June	201.4	208.1	192.1	205.4
July	204.9	209.7	192.3	207.8
August	205.4	212.4	192.1	209.6
September	*204.8	212.5	*193.2	*209.4
October	....	213.1	....	....
November	....	....	....	....
December	....	....	....	....

*Preliminary. †Used only in computing the Labor Component. ‡Minor change in basis of Material Component. U. S. Bur. Labor new basis. §Minor change in Miscellaneous Equipment index. Adoption of some Bureau of Labor items. ¶Transition during August-November to new basis for Materials Component. Decreased Iron and Steel from 60 to 50 per cent, and increased Miscellaneous Equipment from 20 to 30 per cent.

Octane Numbers of Reformer Feeds (A correction)

Your correlation of August 26, 1957, of catalytic reformer yields is remarkably useful but the octane numbers of the feed stocks do not seem to check well. Perhaps the boiling range of the feed is significant? S.D.K.

Boiling range of the reformer feed has a most significant effect on the octane number of the feed material. This is evident in Fig. 1 and it is obvious that the use of a single relationship between characterization factor and octane number for catalytic feeds, as used in the August 26, 1957, issue, is misleading. Although Fig. 1 is based on more than 65 experimental points taken from the literature, it is still approximate because variations are large. Thus, one 305° F. midboiling-point stock of 12 characterization factor has an octane number of 34.5, whereas it should, by the correlation, have an octane number of about 29. Likewise, a 274° midboiling-point sample of 11.5 characterization factor had an octane number of 60.3 whereas it should have been about 72.

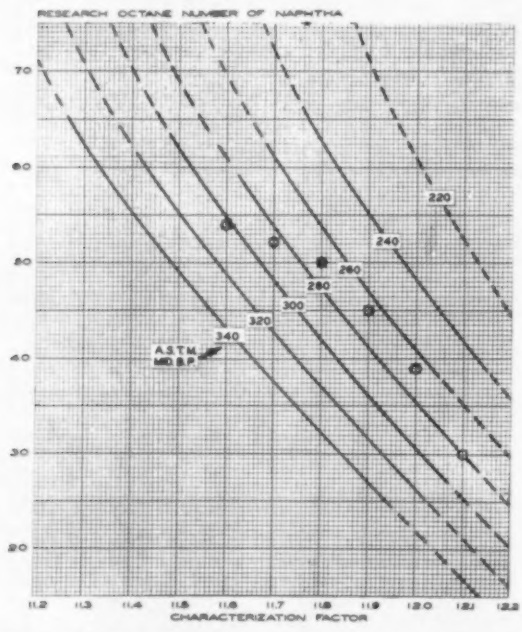

Fig. 1—Octane numbers (approximate) of reformer feeds. End points are normally below 400° F. (Circle points are the octane numbers used in Questions on Technology, August 26, 1957.)

One of the economic factors of catalytic reforming is forcefully evident from Fig. 1 and the yields (platinum catalyst process) correlation of the August 26 issue. A much greater increase in octane number is obtained when reforming a high-boiling-range feed material. The octane number of the reformate seems to be little affected by the boiling range of the feed material (Zielinski, "Relationship of the Composition of Reformer Feed to Reforming Yield," A.C.S. meeting, September 8, 1957, Petroleum Division), being mainly a function of the characterization factor of the feed material. Thus, at a 90 per cent yield of debutanized reformate (about 94 per cent including butanes), the increase in octane number when charging 260°, 300°, and 340° F., midboiling-point feeds is as follows:

C.F. of feed:	Increase in O.N. for these mid-B.P.'s of feed 260	300	340
11.4	....	25.8	40.3
11.6	19.3	34.4	45.7
11.8	27.2	38.8	48.7
12.0	33.7	44.0	52.5
12.2	41.3	50.7	....

At an 80 per cent yield of debutanized reformate, the increases are even more attractive:

C.F. of feed:	Increase in O.N. for a 340° B.P. feed 90 per cent yield	80 per cent yield
11.6	45.7	56.4
11.8	48.7	60.5
12.0	52.5	69.4

The best way to use reforming capacity is evident some place among these relationships, and one important factor is the use of the highest boiling range of feed available at the refinery.

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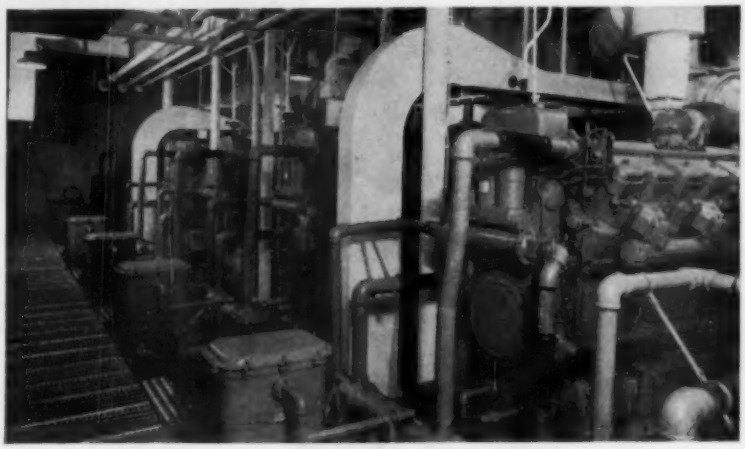
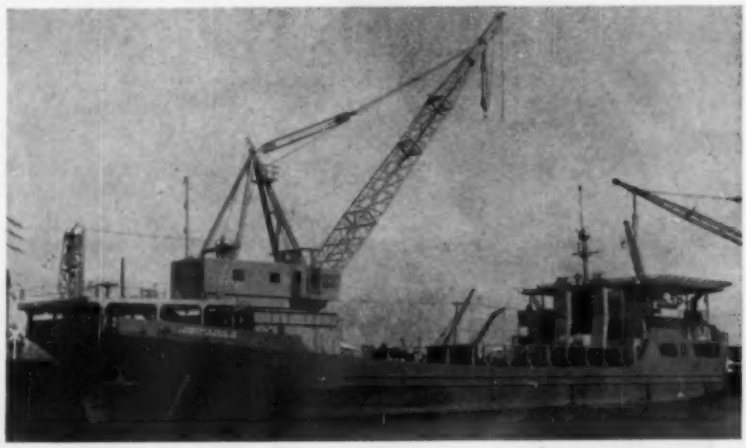


First dual-purpose power plant is installed on gulf's



most powerful drilling tender. It's powered for . . .

20,000-Ft. Offshore Drilling

Coastal - Marine Drilling & Construction Corp., of Houston, will put into service in the near future the most powerful drilling tender ever to operate in the Gulf of Mexico. Self-propelled, the vessel is the first of its type to have dual-purpose main power units, designed to be used either for drilling or ship's propulsion.

The tender, named the "Howard C. Cole, Jr.," after the company's president, had arrived at Beaumont, Tex., after a 10-day trip under its own power from Camden, N. J., where it was built by New York Shipbuilding Corp.

Arriving with it was the tender's service vessel, a 132-ft. cargo ship, named the "Irwin W. Alcorn," after the drilling company's vice president and general manager. It was constructed concurrently with the tender in the same shipyard.

Delivery also has been made at Beaumont of the company's new drilling platform and its contained equipment which the tender and cargo vessel will service. It was supplied by

Ideco, one of the Dresser Industries, of Dallas.

The 272-ft. platform tender has a 56-ft. beam, a 17-ft. loaded draft, and, with its component platform-drilling assembly, is rated to drill to depths in excess of 20,000 ft. It also is fitted with a large-capacity deck-mounted crane, which gives it the ability to do construction and salvage work when not serving its drilling platform.

Its dual-purpose 3,500-hp. diesel-electric power plant contains five sets, consisting of Caterpillar D397 turbocharged engines driving GE-752-J1 differential compound - traction - type d.c. generators.

On location, these five units supply electric power to the drilling equipment or the deck-mounted 60-ton crane. For moves, when there is no demand on the engines for drilling power, the power is redirected to drive the vessel's twin screws through two 600-hp. marine propulsion motors.

Drilling equipment served by the main electric sets includes two Gardner-Denver 1,000-hp. mud pumps, located in the tender's bow, and the Ideco E2500 double - drum, air-controlled draw works and 27½-in. rotary table, carried on the drilling platform.

Two G.E.-752-H2 d.c. motors, individually rated at 600 hp. at 900 r.p.m., drive each of the pumps, each of which has a maximum capacity of 880 g.p.m. at 65 s.p.m. Two shunt-wound modified traction-type d.c. motors are mounted on the draw works. Each has an intermittent rating of 800 hp. A 752-H2 traction-type 600-hp. d.c. motor powers the combination cat works and rotary drive unit.

In addition to the main power plant for drilling and vessel propulsion, the tender carries two a.c. electric sets for the auxiliary power equipment.

A standby pump-and-generator unit is provided on the drilling platform for use if the tender is forced to pull away from the platform under emergency conditions. This is capable of maintaining circulation and rotating the drill pipe, or hoisting.

The drilling assembly on the platform uses a Parkersburg 1,100,000-lb.-load-carrying-capacity derrick designed to withstand 125-m.p.h. wind velocities.

The tender has four bulk barite storage bins, located forward and adjacent to the mud pump room, and having capacity of more than 5,000 sacks. It carries a dual Halliburton cementing unit, equipped with cementing pumps powered by two diesel engines. This and two bulk cement-storage bins with a 2,500-sack capacity are located in a separate compartment below the main weather deck.

Storage racks for the tender's initial stock of 15,000 ft. of 5-in. drill pipe and 15,000 ft. of 3½-in. drill pipe are located amidship on the weather deck.

Air-conditioned living quarters, dining and recreation rooms are provided for 58 men, the tender's complement.

Raymond T. Newman will be tool pusher on the rig. This will be the second offshore drilling assembly to be operated by Coastal-Marine.

Earl Harter, Shreveport, has contracts for two 3,500-ft. wildcat tests southwest of Curry, in Winn Parish, Central Louisiana. They will be drilled for W. Carlton Green, also of Shreveport. One location, 1 Tremont, in 20-10n-1w, is about 3½ miles from town. The other, 1 McCartney, in 21-10n-1w, is about a mile southeast of the first. They are Wilcox tests.

Beck Oil Co. has contracted for another Beauregard Parish, Louisiana, wildcat test. Its newest job is for Kilroy Co. of Texas at 1-B Lutcher-Moore, in 36-5s-12w, about 1½ miles south of Pine Grove area, in the western part of the parish. It is about 3 miles southeast of Bivens field. A 9,500-ft. test is planned.

Vick Drilling Co., Winnsboro, La., is on a new contract job 4 miles west of Slocum, in southern Anderson County, East Texas. It is a 6,200-ft. Woodbine test for F. R. Jackson, of Longview, Tex. It is on Jackson's Holcomb lease in the Philip Martin Survey. Location is about 1½ miles northwest of another Woodbine wildcat which **Gibson Drilling Co.,** of Kilgore, Tex., has been drilling for British-American Oil Producing Co. The latter is at 1-B Florinda Moore, in the Sims Survey.

Southeastern Drilling Co., Dallas, has a new deep operation scheduled in St. Mary Parish, southern Louisiana. It is a contract job for George R. Brown at 1 Jeanerette, in 27-13s-12e. Location is about 3 miles north of West Lake Verrett field, nearest production. Permit calls for drilling to 13,000 ft.

W. P. Taylor Drilling Co., Houston, has a rig running on a 6,650-ft. wildcat test 3½ miles south of Pierce, in Wharton County, Texas Gulf Coast. Drilling is on contract for Caribbean Oil Corp. The test is carried as 1 Dole. Spot location is in the ET RR Co. Survey.

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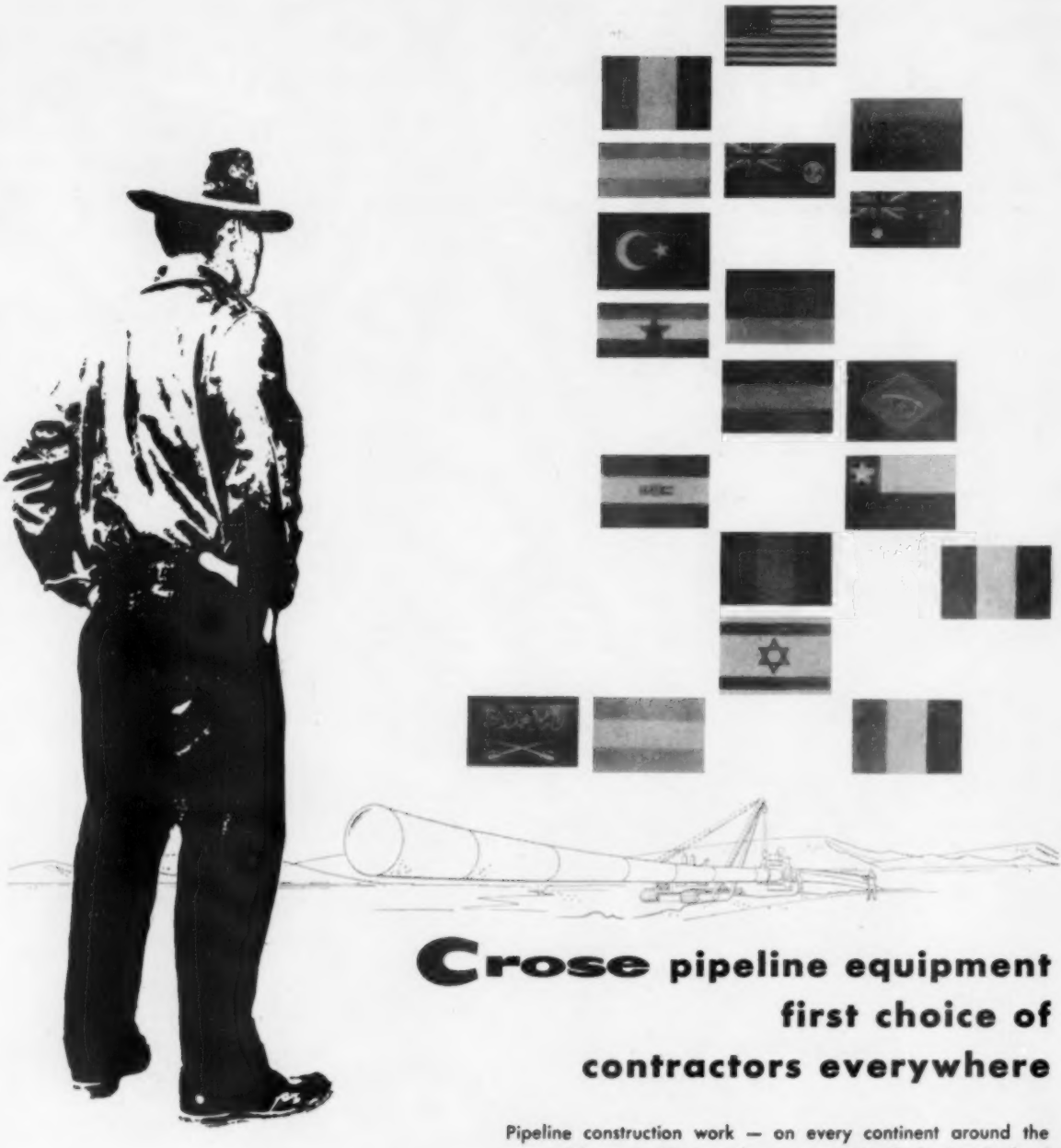

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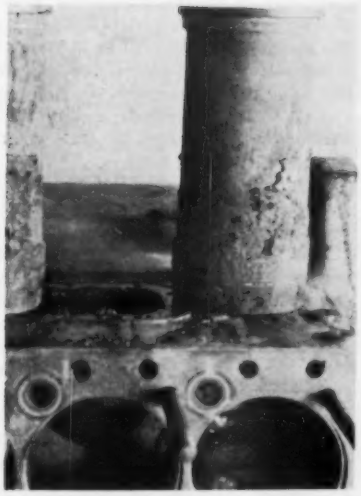
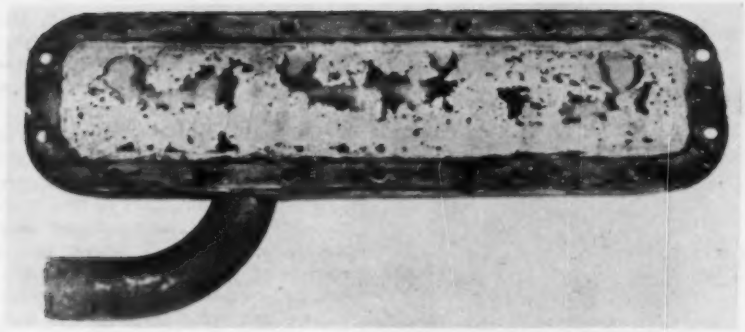
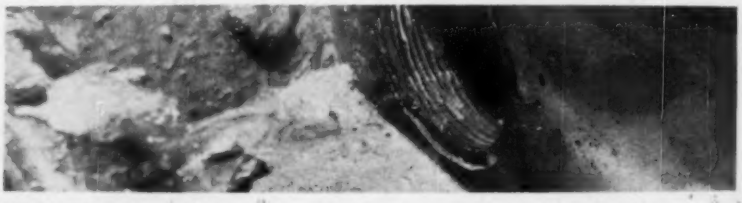


OVERHEATING results from scale formation such as this on cylinder blocks.



COOLING-JACKET and cylinder heads may be ruined by scale formation as shown here.



SLUDGE must be flushed out of engine oil reservoirs after scale-forming salts are converted to solution.

These examples of scale formation show why . . .

Cooling-system maintenance pays off

By Dan Haack
Mid-Continent Pipe Line Co.

SCALE causes overheating and "hot spots" which lead to cracked cylinder heads and blocks, and therefore must be prevented at all costs. The best cure for the scale problem, of course, is to use only extremely soft natural water, rain water, or distilled water. Most cooling-jacket scale formations are caused by the precipitation of calcium and magnesium salts from so-called "hard" waters.

Where only hard water is available a commercial water-softening treatment such as the Zeolite method would be the most desirable step. However, it is often necessary to use such water in an untreated form, and where this is the case, you should drain and renew the water often to prevent a concentration of mineral matter building up as a result of evaporation. Overflow tanks, pressure caps, and similar devices which hold down evaporation rates are helpful.

There is also considerable evidences to show that the use of zinc anodes is valuable in this respect. These devices act as a miniature battery, causing a small electric current to be generated which reputedly renders the scale-forming salts inert. They remove hard scale which has already formed by precipitating it back into solution, then converting it into a soft, gelatinous sludge which will settle, and can be flushed out.

Field tests . . . I have a detailed field report showing conclusively that ⅛-in. of hard, preformed scale was completely removed from five 165-hp. pipeline engines in 7 months' time by the use of this method. These engines were operated by a major pipeline company in the Oklahoma City area. The use of zinc anodes also was recommended to us by one of our major engine suppliers, as a solution to a cylinder-sleeve deterioration problem we were having several years ago. We have had three of these electrolytic treaters under test in 125-hp. engines for 2 years, and the current reports seem favorable. However, we do not seem to be troubled much with scale either in the test engines or elsewhere, so the results are not apparent at this time.

Water Supply (Automatic Exhaust Condensers)

Where there is trouble obtaining plenty of good radiator water, the automatic exhaust condensers may be of interest. These condensers take part of the engine exhaust gas and condense the moisture from it. Then, as the radiator level drops through evaporation, or slight leakage, a float control allows the mineral-free water to pass into the radiator. Up to 15 gal. of makeup water per day can be fed into the cooling system from this source—enough for a 500-hp. engine operating under heavy load. Since

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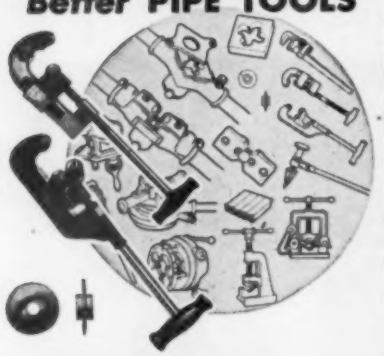

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the amount of moisture in the exhaust varies directly with load, the condenser supplies maximum water when it is most needed. Excess water formed is drained off through an overflow outlet.

The question often arises as to whether the water formed from the exhaust gases is corrosive? The answer is no, not any more so than most natural waters. The condenser is a double-cylinder affair which has a method of separating the solid particles of combustion from the exhaust gases. These solid particles, and first-formed condensate, are drained off through a separate outlet and are not allowed to enter the radiator. We have laboratory analyses of coolant samples taken from engines after a year's operation without even using a corrosion inhibitor.

Samples . . . No evidence of excessive corrosion was indicated, nor were the samples much different than might have been expected had natural water been added instead of the exhaust condensate. It is evident that by merely adding a good corrosion inhibitor like sodium chromate, any possible worry about corrosion can be dismissed. This is borne out by our own experiences, as we have three of the devices installed on 100-hp. engines. In the 3 years of operation, performance has been satisfactory from every standpoint.

Water Pumps

Engine water pumps are of centrifugal design in all cases, and may be either of the packing gland, or packless type. The packing-gland types must be tightened up occasionally, and lubricated periodically. The packless pumps have a built-in, self-adjusting seal, and may or may not need periodic lubrication.

One thing to remember is to avoid overgreasing water pumps. The excess grease will find its way into the cooling system. This is undesirable because the rate of heat transfer from the engine parts to the coolant is reduced. When oil or grease has entered the cooling system from one source or another, we circulate a solution of trisodium phosphate through the jacket for 12 to 24 hours, then drain and flush with clean water.

Thermostats

The function of the thermostat is to regulate the temperature of the engine by controlling the rate of coolant circulation. The main purpose is to prevent overcooling of the engine during light-load operation in cool weather. Overcooling causes waste of fuel, loss of power, and rapid wear of the engine. Even in hot weather, the thermostat is helpful as it permits a fast warmup and thereby cuts down the total time the engine is running too cool. Our standards specify that thermostats be kept in the water jackets the year around.

Occasionally it may be necessary to remove thermostats temporarily because of defects and like reasons. If this is done, remember to plug off the bypass tube temporarily or serious overheating will result. We have found that one of the best ways to insure against overheating not caused by maintenance difficulties is to order new engines equipped with the so-called "tropical" radiators. These cores are thicker in cross-section than standard cores, usually having one more row of tubes. We feel that the use of such heavy-duty cooling equipment is justified in the Southwest where summer temperatures often approach or exceed those found in many tropical areas of the world.

Corrective cleaning of scale and rust . . . If through neglect, scale and rust have been permitted to build up in a cooling system to the extent that the engine overheats, immediate steps must be taken to clean out the system. Only safe and dependable cleaning compounds should be used and manufacturers instructions carefully followed. Alkaline cleaners such as washing soda and the trisodium phosphate we use are effective for removing greases and oils but have no solvent action on rust or scale. Oxalic-acid and sodium-bisulfate types are satisfactory for dissolving the hard deposits. Always follow acid type of cleaners with a neutralizer to end any corrosive effects that may have been introduced.

The thermostat should be removed during cleaning and the radiator-air flow cut off so that a temperature of about 200° F. is maintained. Of course, the engine should be allowed to cool well below this temperature between flushings before adding any cold water. For best results, follow the corrective cleaning with an air-and-water reverse flow to remove any loosened solids; then flush in the normal direction of flow. In the most severe cases of water-jacket clogging, the cleaning solution may not be able

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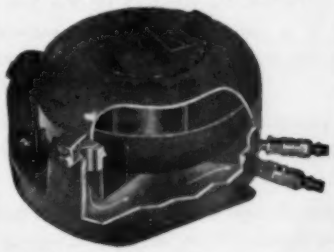

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to reach the deposits. The only remedy is to remove the radiator, core-hole plugs, cover plates, etc., and manually rod out, or scrape out, the deposits.

Cooling System and Other Engine Systems

One of the frequently overlooked effects of poor cooling-system maintenance is the effect on the lubricating system. Overheating of the engine in general reduces the viscosity of the oil below a safe value. If the oil gets too thin, metal-to-metal contact will occur, and a high wear rate is the result. Worse still, high engine and oil temperature will cause some of the oil to be partially oxidized or "cracked." This leads to the formation of gums, resins, carbon, organic acids, and other harmful products which mix with the good oil and circulate through the system.

Often these contamination products cannot be detected by a visual examination of the oil itself. If oil-purification equipment is not mounted, or the oil is not drained oftener, the result will be stuck piston rings, lacquered pistons, corroded bearings, and a host of other troubles. At this point the operator may place the blame on the brand of lube oil or the oil filter, while at the same time overlooking the real cause—cooling-system neglect.

On the other hand it is fully as important that the engine not be permitted to run too cool as it is to prevent overheating. If crankcase temperatures drop below 140° F., crankcase condensation becomes excessive, and the increased lube-oil viscosity sharply reduces the efficiency of the oil filter. Water condensate is the most damaging single substance which can enter the lube-oil supply. This is true because it accelerates the formation of corrosive acids, and is one of the essential ingredients of that pasty, black, mayonnaise substance we know as sludge.

Lube-oil heat exchanger, or so-called oil coolers, are essential whenever the range of 140° to 260° F. crankcase temperature is exceeded in either direction. We strive to maintain at 10° F. temperature differential between the engine-jacket inlet and the outlet. This results in a more uniform temperature of the cylinders and a rapid circulation of the coolant which prevents the formation of steam pockets causing hot spots.

Sparks of plenty...

East of the Appalachians, there is much evidence of Transco's continuing development of good markets for natural gas. This provides a plentiful supply of gas for the Eastern seaboard. It also assures stable income for the producers of Texas and Louisiana — by taking their gas to the places where the most people are.

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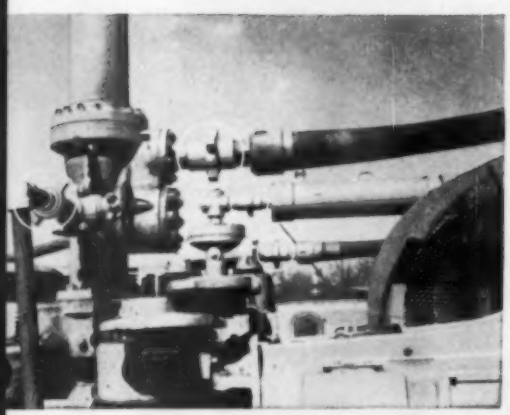

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OIL isn't strictly BIG business

There's plenty of room for the *little* ones

IN AN ERA when the business trend is toward bigness that brings economy and efficiency, when the urge to merge, integrate, and diversify is strong, the future of small business is a serious concern to the public.

This makes the oil industry a natural target of politicians.

For oil is big business. It has to be. The rapid growth in consumption and the job of supplying 67 per cent of the nation's energy requirements demand huge aggregations of capital. Aggressive managers and inventive technologists have always found opportunities to expand their operations. Half a dozen oil companies rank among the biggest corporations in the world.

But it doesn't follow that there is no place in the oil industry for small business. On the contrary, there are thousands of small oil businesses, and they are represented in every branch of the industry. In some branches the small businesses predominate.

It is hard for the man in the street to believe this. He knows oil is a mammoth industry and that it has spawned mammoth companies. He notices only half a dozen gasoline brand names on filling stations in his locality. He sees only half a dozen oil-company names in his newspapers. He is familiar with the stock listings of only a few of the largest oil companies.

Where are the thousands of small businesses in the oil industry, and how can they exist in an industry that appears to be dominated by just a few giants?

The answers lie in a peculiar partnership between big and little units in this ramified industry—a partnership that may be unique with oil and that has existed since the earliest days. This partnership is not a magnanimous live-and-let-live attitude on the part of the "bigs." It is based on practical business and economic considerations.

Small businesses exist in the oil industry because they can do many things better than the big operators. The small companies aren't parasites, to be eliminated in the interest of efficiency. The big companies need them, often couldn't get along without them. And the reverse is true. The structure of the oil industry is an interdependent web, with large and small segments contributing each to the other.

In some cases small business supplements big business in oil—that is, it is in direct competition, filling in the gaps and chinks not occupied by the bigs. Here the small operator holds his own chiefly by being more aggressive, more flexible, more progressive than his big competitor.

But in more cases small business complements big business in oil—this is, it performs services that the big companies can't do for themselves as well as the small ones can. That's what makes the relationship a sort of a partnership.

The best test of how small business is faring in the oil industry is to examine the ease or difficulty of starting a new enterprise and how the smalls are treated by the bigs.

In some branches of oil it is admittedly difficult for a new small outfit to get started and to compete successfully—notably in pipelining and in refining. Yet more than one has done so in recent years.

In other branches it is easier to get started and make a success of it—though almost always it requires a big hunk of capital and much specialized know-how.

HOW SMALL BUSINESS IS SUCCEEDING IN OIL ▶

EXPLORATION—little man's domain

EXPLORATION is the foundation of the oil industry, and it is in this division that the independent is most prominent. Of some 13,500 wildcats drilled in this country last year, 80 per cent were credited to independents. They also play a leading role in every step of exploration prior to drilling the test, from seismic survey to staking the location.

In exploration, more clearly perhaps than anywhere else in the oil industry, is the partnership of big and small business illustrated. This partnership is carried out through farmouts to independents, who drill on lease blocks put together by the big companies, and through dry-hole money with which an interested company with nearby acreage supports a test hole.

Farmouts . . . Major companies go out of their way to make farmouts available to the small oil operators. Many small operators rely entirely on the majors for the farmout, the geological information, and technical advice.

The small operator takes the risk in drilling the well; the major benefits along with him if the farmout is successful since the well usually proves up acreage retained by the major. The system is the unique way which has been worked out to do the whole job of finding oil, and the trend is toward utilizing this partnership still more fully.

Independents rely heavily on farmouts to supply their drilling needs, and the major companies are only too happy to provide them. The farmout route is a two-way street, giving the major oil company an opportunity to evaluate acreage by drilling at low cost and at the same time giving the independent a lease block for practically no cost up to the point of drilling.

Major companies are quick to point out that they don't give farmouts away. Competition is keen for good farmouts, and the major can drive a hard but fair bargain. In many instances, the major provides the geological idea, along with the farmout acreage. More often than not, the major will have its own geologist sitting on the well to check for shows, evaluate drill-stem tests, and the like. In these instances, the major is providing the independent with an exploration staff as well as acreage.

Here's the experience of one major during 1956. The company drilled 54 exploratory tests. In the same period, it had 482 farmouts drilled. Of these, 365 were exploratory tests, the remaining 117 were edge wells, marginal field wells, and the like.

Contrary to popular belief, farmouts are not culls. Major companies require good reasons for acquiring leases. Later these reasons may not be strong enough arguments to convince them to drill. Or the acreage situations may not be favorable to drill a test without help, but an independent can put together enough acreage by farmouts from several operators to justify a test. Or there may be a holdout in the block, demanding a test before he will lease. Another major's figures prove that farmout drilling is profitable for all concerned. Results run as high as one producer out of every five farmouts in some districts. Their figures showed that farmouts hit better than one out of every nine in exploratory tests.

Consultants . . . These specialists have become more numerous as oil finding has become increasingly technical and more of an exact science. They range from geologists, geophysicists, and logging experts to lease men. All are small business men.

Let's define some terms . . . SMALL for instance

. . . or can we?

HOW SMALL IS "SMALL"? Nobody has ever come up with a universal definition of "small business." It varies widely from industry to industry. In oil there are scarcely any small businesses as small as those in the retail or service industries, for example. It takes a lot of capital and usually the combination of the talents of several men to get into most phases of the oil industry. Some of the very small companies in oil would seem like giants to small business men in some other lines. Yet they may be pygmies alongside the major companies.

In the early days of oil, the words "small" and "independent" were synonymous. Independent meant independent of the old Standard Oil Trust or one of the companies resulting from dissolution of the trust in 1911. But today some of the former independents are bigger than some members of the old Standard family. Today we use the term "independent" to mean a company or operator not included among the 30 leading majors.

Another distinction used in the industry is between integrated and non-integrated companies. An integrated company engages in all or several of the industry's operations—producing, refining, pipelining, and marketing. But today many truly small and independent units are integrated, while some very large companies stick to just one branch of the business.

So in evaluating the place of "small business" in the oil industry it is virtually impossible to draw a definition of what is small.

Take three high-caliber geophysicists

Add a sound knowledge of oil exploration and business acumen

Mix well with imagination and aggressiveness . . . and you have the makings of a

Successful small geophysical company

THIS FORMULA is one that has been used in exploration work since the first blast of dynamite uncovered a Gulf Coast salt dome. And the firm of Thralls, Green & Perry, a recently established Tulsa geophysical contracting company, fits into the pattern. Their growth has been almost spectacular since the company was formed in 1954. At a time when most geophysical work has been seriously curtailed, Thralls, Green & Perry has expanded from the original crew in 1955 to seven crews today.

Their success is largely due to tailoring their service to fit the client's needs. Maynard Green, one of the partners, claims that success in seismic work occurs at and below the supervisor level. And Thralls, Green & Perry is composed entirely of working geophysicists. Each of the three partners is a working geophysicist, supervising the field results. In this fashion, they give individual attention to the particular needs of their clients and coordinate closely the seismic data with the known geology and current developments.

IN PHOTO: R. E. McMillen, chief geophysicist for Midstates Oil Corp., Tulsa, consults with Waynard B. Perry, Hugh Thralls, and Ted S. Green in reviewing a seismic record section.

Of the 14,000 members of the American Association of Petroleum Geologists, more than 20 per cent are independents or consultants. They perform a multitude of services from evaluating acreage to recommending a long-range exploration program or advising a state conservation commission.

Most consultants start their own business after gaining experience with an operating oil company or exploration contractor. Their services are required particularly by the small company which cannot afford to have its own exploration department.

Consulting is a favorite avenue for entering the oil business. Since the consultant sells a professional service, overhead is low and a minimum of capital is required to start.

Seismic contractors . . . Seismic surveys illustrate well the role of the specialist in modern oil finding. Few if any of the contracting seismic companies, which are the backbone of today's exploration, are big businesses in any sense of the word.

Basically all of these geophysical companies have followed the same success pattern. An astute geophysicist recognized the need for a company that would fit a particular situation. He provided the answer in the form of a new and expanding company.

How does a small seismic contractor get started?

Usually three financial routes are open. Three or four individuals pool their capital and technical resources to form the new company. Another means is to interest outside capital. The "angel" is invariably a man familiar with the oil business, although he may not be directly connected with exploration.

The third route into seismic contracting is the most hazardous financially. The geophysicist through professional contacts lands a long-term contract for one crew. On the strength of this contract, plus a small amount of cash, he can borrow money to start operations and become a competitor of his former employer. There are numerous small contracting companies that trace their lineage to Seismograph Service Corp., Geophysical Service, Inc., United Geophysical Co., or to one of the other large contractors.

A good barometer of business health is the opportunity for new companies. The opportunity is still there in seismic contracting, although capital requirements are much greater. Once you could start out on a shoestring—one of the largest contractors pyramided an investment of $10,000 into a company recently valued at more than $8,000,000. Today a recording truck alone costs in the neighborhood of $100,000 if it is equipped with the most modern electronic and magnetic instruments. However, still more new small companies continue to enter the field.

Small contractors own most of the rigs

ONE CONTRACTOR owns 92 rigs, and there are a dozen who own 20 or more. But the drilling-contracting business is essentially the little man's game. Contractors with three to five rigs each are the largest single group, and the one and two-rig owners are next. The ownership breakdown is shown in the table, based on reports of 1,219 contractors to The Oil and Gas Journal.

The 1,219 contractors own 3,937 rotary rigs, according to the Journal survey. Here's where they are located, according to contractors' home offices.

OWNERSHIP OF ROTARY RIGS FOR 1,219 CONTRACTORS

Groups of contractors and number rigs owned—	Rigs owned	Per cent of total
12 contractors own more than 20 rigs each	405	10.29
38 contractors own from 10 to 19 rigs each	474	12.04
100 contractors own from 6 to 9 rigs each	690	17.52
372 contractors own from 3 to 5 rigs each	1,370	34.80
697 contractors own from 1 to 2 rigs each	998	25.35

State—	Contractors	Rigs
Illinois	71	145
Rocky Mountain Group*	95	253
Kansas	102	233
California	64	228
Oklahoma	201	816
Texas	537	1,799
Louisiana	77	286
Others	72	177

*Incl. Colorado, Montana, Wyoming, Utah, North Dakota, New Mexico, South Dakota, Nebraska, and Idaho.

DRILLING—it's mostly small business

ONE REASON for the growth of small business in petroleum is the dispersal of functions formerly performed by big companies themselves. One of the outstanding illustrations of this trend is the rise of the drilling contractor. Oil companies which formerly did most of their own drilling with their own rigs have found it profitable to contract their wells for the most part. The contractor can do the job cheaper and often better.

It is often said that the best drilling tool the industry has is a hungry contractor. Since service is all the contractor has to sell, the contracting business has remained primarily one of small companies where owners can keep close watch on every rig. Today, about 60 per cent of all rigs are operated by contractors with five or fewer rigs. These small contractors actually dominate the entire field of drilling.

The Oil and Gas Journal's industry census lists 1,219 contractors, and 697 are one and two-rig owners. There are 372 contractors with 3 to 5 rigs, 100 with 6 to 9, 38 with 10 to 19, and only 12 with 20 rigs or more.

Even the big ones are unable to monopolize drilling in any area. The contracts go to the rig which cuts the fastest hole, has efficient and safe equipment, and digs at the lowest cost per foot per day.

When companies owned their own rigs, it was often a battle to find worth-while prospects to keep them busy. As a result, the company rigs were frequently stacked, waiting on a location. Besides, buying rigs ties up the oil company's capital unnecessarily.

But contractors can move rigs around to work for several companies in the same area. They can keep their rigs busy a greater percentage of the time. And, a good contractor can operate with lower overhead than the oil company's drilling department. Company rigs now are relegated mostly to experimental work and deep wildcats.

Contract drilling is like few other businesses in that size is seldom an advantage. The reason is that you can work but one rig on a hole. Only one crew can operate the rig. You couldn't make hole faster, cheaper, or better by bringing in twice as many men or two rigs. All you can do is put on the hole a rig that is big enough for the job but not too big to be economical and use your know-how to get the most out of it.

The men heading small contracting firms often do double or triple duty. For instance, an owner or part owner of a one or two-rig firm might be his own drilling superintendent, tool pusher, contract representative, and office manager. And, since he has a share of ownership, he'll work longer and harder than if he were on salary for someone else.

Opportunities . . . How do you get into the drilling business?

A contractor can expect some of his good men to quit and buy themselves a rig. Although contract drilling remains one of the most competitive of contracting businesses, this fact seems to deter few tool pushers with a yen to own their own tools. To be sure, to compete today the contractor needs more technical know-how and more business sense to survive competition and meet the challenge of greater depths and new areas. But there are still plenty of men who make down payments on rigs, mortgage themselves to a supply company, and go into the contracting business for themselves. Drilling engineers for oil companies make the move, also. Many succeed. They usually stick to shallow and medium-depth areas where long activity has made drilling programs almost a matter of "turning the crank."

But you don't have to own a $200,000 rig to be a part of the drilling industry. Small businesses abound that sell a service of one sort or another to the drilling contractors. The job of running casing is one valuable service that small businesses provide. Periodic inspec-

tion of drill pipe is provided by several small companies.

Every new oil field or new oil province offers numerous opportunities to the aggressive and experienced little man. Well-completion units are always in demand. And with new wells comes the need for servicing units. Several companies will straighten pipe, replace drill-pipe connections, handle mud logging, check for shows of oil or gas, analyze cores, install instruments to check drilling rates, stake new locations, prepare ground for the well site, and truck drilling equipment on and off location, fish for lost tools, and build rigs.

Cable-tool operators, numbering about 1,500, are still an important part of drilling in shallow areas. Many cable-tool businesses are family operations. The father owns the unit and works as driller. His son or brother is tool dresser. Their profit isn't large, but cable-tool drillers have a definite place and account for many thousands of feet of hole every year.

Contract drilling is anything but a static business. New provinces bring new problems and new opportunities. The search for oil under the oceans has produced a number of new companies. The fact that offshore drilling is at best a very risky and expensive proposition has not scared newcomers away. They have joined the established drilling firms in a new venture fraught with all manner of risks from hurricanes to blowouts.

PRODUCERS—16,000 of them

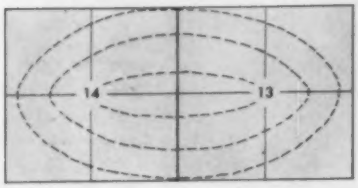
OPPORTUNITIES in production are still present, perhaps in larger measure now than ever before. Small operators are taking advantage of them, too, as production statistics prove. There are some 16,000 companies or operators in the United States, most of them small. About 15,000 small independents produce 13 per cent of the nation's crude oil, according to the Journal's industry census; 21 per cent is produced by 800 larger independents, and the remaining 66 per cent by 31 major integrated companies.

The small companies have increased their share of total production in recent years. In 1948, the 25 largest oil producers accounted for 52.5 per cent of total U. S. production. In 1955, the big companies' share dropped to 47.5 per cent. The largest producer in the country has only 5 per cent of the total.

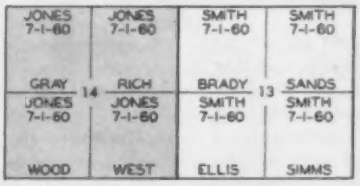
Producers, large and small, need a multitude of service companies to drill, complete, and place a well on production. These include mud-service companies, mud distributors, logging and perforating service companies, core-analysis laboratories, trucking contractors, cementers, drill-stem testers, and well-completion consultants. Almost any operation concerned with producing oil and gas wells—including the actual management—can be contracted out to consultants. The increase in secondary recovery, in particular, has created an enormous field for consultants.

The small supply company also has its place, although in general the big-volume items are handled mostly by the larger companies. The small houses handle a volume of business that might not attract the large company, or get in early in a new area, build up

How a consulting geologist becomes an "independent"

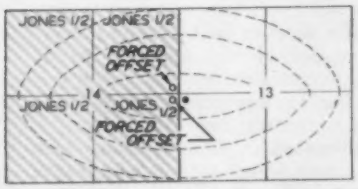


STEP A . . . John Jones, consultant, finds a promising structure and acquires leases under 8 quarter sections subject to a well within 6 months.

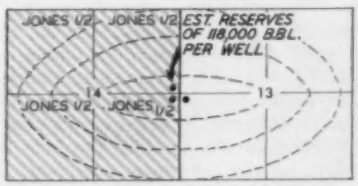


STEP B . . . Jones turns the drilling deal to George Smith, drilling contractor. Smith gets leases under 4 quarters, Jones gets $5,000 cash.

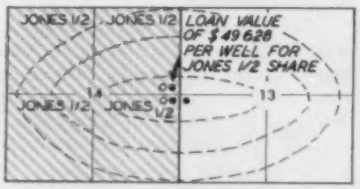
STEP C . . . Smith sells his interest in 3 quarter sections to cover drilling costs. The well is a discovery with production from 5,820-30 ft.!



STEP D . . . Jones, faced with drilling two offsets to the discovery, sells half his interest in return for two wells, free of cost to Jones. He will, however, get half the oil from these wells. Both wells hit!



STEP E . . . Jones now has substantial assets in the form of oil reserves, his half interest in two producers. He contacts a bank for an oil loan.



STEP F . . . Bank's oil and gas department looks over the property and will lend Jones initially $99,256 to cover his drilling costs. Ultimately they will lend him 1 million dollars. Jones is in the oil business!

We give you Mike Halbouty

independent oil man

a satisfied set of customers during development of the field, and then reap the benefits of their enterprise throughout the life of the oil field. Many small companies prosper with a single specialty item which they may also manufacture.

The independent has a strong ally in the conservation laws of prorating states, although proration at best is considered a mixed blessing by the small operator. Since he depends on current income to finance operations, it is vital that the independent receive his fair share of the crude market. Allocation of production over all fields in a state tends to assure him an outlet for at least some of his output.

The Department of Justice, in a report on the oil industry, stated recently: "It is indisputable that the relative decrease in markets since 1951 and the concomitant reduction of state-fixed allowables has had far greater effect on the independent, nonintegrated producer than on the larger, integrated units of the industry. In investigating company activity in the two states (Texas and Oklahoma) discussed, however, it seems equally apparent that, but for the operation of the regulatory systems of those states, the decline in markets might have had more serious consequences to the independent segments of the production level of this industry."

The partnership aspect of the oil business is illustrated well in unit operation of fields in which several producers are represented. While individual producers may not like a specific participation formula, the unit works to the benefit of all through more efficient operation and increased recovery. The interests of all producers, large and small, are protected.

Joint ownership of natural-gasoline plants is another instance of partnership involving competitors. If a large producer built a plant just to handle his own gas, others in the field would not be able to profit from their small holdings. Their volume would not justify a plant to extract the liquids. However, under joint ownership, all participate in the processing.

Seven Ways to Become an Oil Operator

Most common ways of acquiring production are:

- **Salvage leases.** Here the buyer acquires stripper leases from an operator or major oil company. Instead of selling the equipment he operates the property.
- **Promoting.** A lease man or other promoter acquires leases and promotes a test. If it hits, he is in the oil business.
- **Buying production.** This is a familiar route and modern engineering studies eliminate most of the risks. The buyer simply purchases a producing property. If possible he will finance the purchase through some form of oil payment rather than pay cash. Some of the production deals get into the realm of big business with purchases involving tens of millions of dollars.
- **Part-interest drilling.** Frequently the drilling contractor will assume an interest in the well as part of the terms of the drilling contract. He tries to make enough money on the well to pay expenses and sacrifices any profit for the interest. Many contractors have used this route to become independent operators.
- **Oil exploration.** Here the small company actively goes out looking for drillable prospects. Usually the company has its own exploration staff, but it may rely on consultants to furnish the prospects.
- **Farmouts.** The small oil company agrees to drill a test well on a major oil company's acreage. In return, the major assigns part of its holdings to the independent. The major supports the independent in several ways: by contributing acreage, by contributing acreage and cash, or by contributing cash only.
- **Dry-hole contributions.** A small operator may own a lease that he cannot afford to drill, and that is surrounded by leases held by major companies. They will contribute money to get him to drill the test, since the well will also help to prove up their property. If the contribution is dry-hole money, the small operator receives the cash only if the well is a dry hole. If the contribution is a bottom-hole contribution, the money is paid upon reaching contract depth.

FROM company geologist and engineer to consulting and then independent operator—this is a favorite avenue into the oil-producing business. Few people have followed this formula with greater success than Michel T. Halbouty, Houston, who has been associated with some famous oil names in his career and now is an outstanding figure in his own right.

Halbouty is known for his supreme self-confidence and unbounded optimism based on a fine educational background and wide experience, particularly in the Texas and Louisiana Gulf Coast area on which he concentrates. He holds B.S. and M.S. degrees in geology and petroleum engineering from Texas A. & M. College, which also conferred on him its first professional geological engineering degree.

After receiving his M.S. in 1931, he joined Yount-Lee Oil Co., the nation's leading independent before its purchase by Stanolind Oil & Gas Co., as junior engineer. In 1933 he became chief geologist and petroleum engineer. Two years later Halbouty took over the same responsibility for Glenn H. McCarthy, a wildcatter renowned for his spectacular successes and failures.

In 1937 Halbouty resigned to enter consulting in order to be able to work for himself. He has continued as a consultant and independent operator since then, except for Army service in World War II as lieutenant colonel.

Success formula . . . Halbouty has had a hand in discovering 38 oil and gas fields in Texas and Louisiana and now operates or owns interests in producing wells in 35 fields. His success has followed a set and simple pattern: Consulting fees in the beginning provided capital to acquire royalty and working interests in wildcats, and income from these investments financed a gradually growing drilling program.

Halbouty and his exploration staff, headed by George C. Hardin, Jr., who joined him in 1946, differ from most independents in their method of operation. They originate most of their own drilling prospects, which are developed from regional geological and seismic work on the Gulf Coast.

All prospects that are submitted are checked by independent evaluation. Even on farmouts from majors, when geological information is offered, they rework the geology on their own. Most of the prospects involving farmouts include acreage on which Halbouty himself has acquired leases for the purpose of drilling. This is true in 90 per cent of the cases.

This formula has produced 23 discoveries out of 60 wildcats drilled since 1951. Fourteen of these strikes are considered in the profitable range—that is, above 2,000,000 bbl. of reserves.

He had a conviction . . . and the faith to back it—it's the Formula for success

HOW CAN the small operator succeed in oil finding today when new fields become harder to find each year? Tom Leach, president of North American Royalties, Inc., and often called "Mr. Williston Basin," claims that successful oil finding depends largely upon fundamental geology. And Tom is speaking from long years of experience as a geologist who has made the changeover and became an independent operator.

Perseverance, Tom adds, is another essential ingredient. His own case illustrates why. He first became interested in the Williston basin in 1928 when he was chief geologist for Transcontinental Oil Co. The Nesson anticline was a natural, he believed. The structure had been mapped on the surface by the U. S. Geological Survey several years earlier, and it lay in the heart of a vast sedimentary basin. Yet 23 years elapsed from the time Leach first became interested in the basin until Amerada Petroleum Corp. completed the now famous Clarence Iverson well in April 1951. Perseverance, coupled with Leach's knowledge of basic geology, netted him an interest in 4 million acres in the basin.

Leach, now a successful small independent, divides his time between the Williston basin, officing in Bismarck, and his other oil interests that he handles from Tulsa. He rightfully has earned the title, Mr. Williston Basin. He had faith in the area back in 1928 when he first started out as a consulting geologist, and his faith is just as strong today. After the first wave of discoveries, the Williston basin began to acquire a black eye because of the large number of dry holes. It looked as though the Nesson anticline was the only profitable spot to drill in North Dakota, although sound geological thinking pointed to other areas. But Leach was not one of those who withdrew from the basin. Now he proudly points to the 1957 discovery record that bears out his confidence in the basin. To date there have been 14 new fields discovered and and lively play is in progress as the Mississippian trend in Canada has finally spilled over into the United States. Needless to say, Leach and his associates have played an important part in this campaign.

Leach is a quiet, unassuming man who could be easily mistaken for an eastern executive rather than one of the best oil finders in the business. He treats his wife as a partner in his ventures and they control 51.77 per cent of the stock of North American Royalties which they organized.

Big REFINERS dominate

. . . but small plants hold their own

THE SMALL REFINER has been challenged severely by competition and technological progress in the past 10 years particularly. The average small refiner has his hands full maintaining his place in the industry, especially if he operates in the shadow of a big plant with lower unit costs. The trend has been away from a multitude of small plants in producing areas toward big plants in or near large consuming centers.

Most small refiners have been faced with the alternative of growing and modernizing or dying. There have been casualties along the way, often because of the technological lag of an individual plant.

Eighty per cent of the refining capacity in the United States is concentrated in the hands of 20 big companies with 100,000 bbl. daily or more. The remaining 20 per cent is divided among 161 companies. Some 85 per cent of the almost 10,000,000 bbl. of daily refining capacity in the United States is accounted for by 100 plants. There are 204 plants comprising the rest.

Small refiner's role . . . How then is the independent or small refiner faring? How long can he survive? How can he survive in a situation where all the economic advantage seems to lie with the big plants and new plants are a rarity?

Surprisingly to some, the independent refiner is holding his own. In fact, a Journal survey shows that the small refiners are adding crude capacity at a slightly higher rate than the majors. The little man has found his place and held onto it by supplying local markets which aren't large enough to justify a big plant or attract a big refiner, by supplying major companies which don't refine enough products to meet their own market needs, or by manufacturing specialty products. The plants which have enjoyed most conspicuous success have prospered for an obvious reason. It's the trite but true story of alert, fast-moving, and aggressive competitors finding an area of need and fulfilling it, while the goliaths of the industry concentrate on the long, steady pull.

The small or independent refiner uses his long suit—flexibility—to stay alive and prosper. This has been a major weapon in his fight to thrive side by side with his major competitors.

The story of refining is tied inextricably with the marketing of petroleum products. Where transportation makes it practical, the major markets products from his own refinery insofar as is possible. However, many areas of the country are too remote from a major's refinery for him to ship his own products. If the major wants to sell aggressively in these areas he must obtain products from the nearest practical source. This will be another company's refinery—probably an independent refinery.

Geography gives the independent his natural place in an isolated or small market. He gets his crude from nearby fields, refines it, and sells it in the immediate vicinity, both to majors and independent jobbers. The independent refiner can't sustain himself on geographic advantage alone, however. He must maintain the technological pace to turn out the quality products demanded by the major customer.

Many contracts are written to pipeline specifications. Octane numbers, vapor pressures, and the like are dictated for shippers on the line. Other contracts are written to meet a particular company's requirements. The independent has to have so much upper-cylinder lubricant in one brand, a special additive in another, and meet the extra high-octane requirements of a third brand marketing a superpremium gasoline. To supply this market the independent must constantly modernize and grow.

Supplying the majors . . . Some independents have carved out a place of their own in the more competitive markets by meeting the major on his own ground. Look at the Texas Gulf Coast, for example. The independent refiner at Corpus Christi or Houston has the majors and other big independents as well, as competitors. He competes against big major refineries able to supply their own station needs and perhaps part of the independents', too.

But the major may not have the capacity, or may not want to supply all his own outlets in a given area. Consider a refinery processing 150,000 to 200,000 bbl. of crude oil per day. This highly complex plant has numerous units, closely integrated and dependent upon each other to produce a variety of products in predetermined amounts to meet a definite schedule. Crude units, cat crackers, cat reformers, alkylation units, hydrogenation units, treating units, and utilities all operate within a general pattern. The major company may have commitments throughout the country and abroad. So you won't find his pattern shifting too much. Operations of one plant have to be coordinated with those of other plants within the company to maintain balanced inventories and supply sales-department demands.

This big plant is regularly turning out its quota of gasoline, kerosine, jet fuel, etc. The octane race has made operations more critical as more and more numbers have been squeezed from existing equipment. Then market research tells the refinery manager that the Detroit auto makers are upping compression ratios again; in 2 years they'll have to supply a lot of 100-octane motor fuel. Maybe the competition is already a step ahead in moving to meet this quality demand. It's already promoting a superpremium.

So the refinery manager looks at his pool octane. The plant can produce so many barrels of 98-octane premium and so many barrels of 92-octane house brand. Maybe there's 1,000 bbl. of 100-octane alkylate or reformate available after blending these components to meet current premium requirements. But the sales department would like to have 2,000 bbl. daily. Present construction could meet this goal in a year, but sales wants it now.

Suppose then our independent refiner put in a new

process unit recently, gaining an octane cushion. He has spare octane capacity and will sell the major enough stock to let him start his marketing campaign. Thus a deal is made profiting the independent who had the vision to move out ahead.

Creating a demand . . . His gamble worked. A demand developed for his extra capacity, which would have cost him dearly otherwise. What if he wants to expand again, and there's no foreseeable market? He tries to create a demand. The independent goes to another major refiner who's thinking of installing new processing equipment to up his high-octane output.

The independent makes him an offer: Why should the major build a small unit to get over the hump now when he'll need a bigger unit later? Why build a big unit now and run it at partial capacity while demand catches up? Why not let the independent supply the blending stock. He can supply it now, cheaper than the major can make it. The fast-moving independent has himself a deal. He's selling to the major in his own territory.

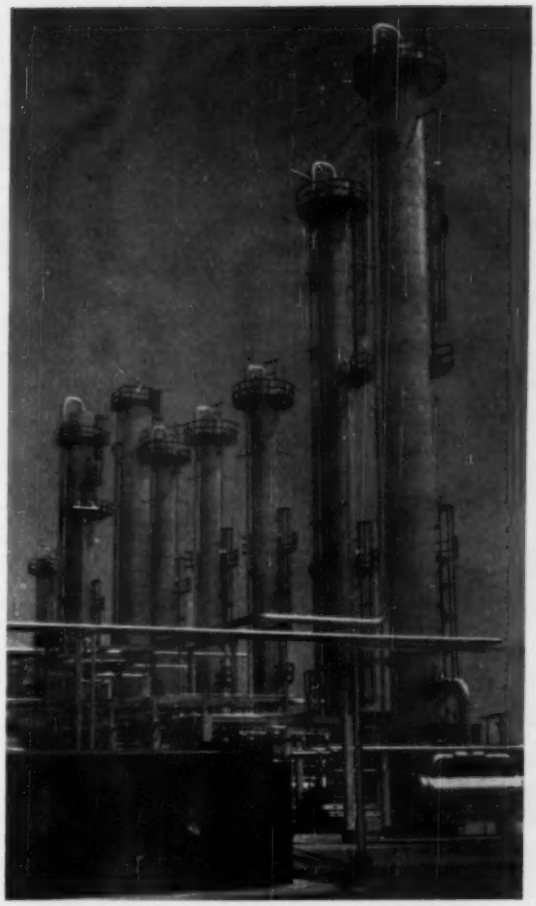
The independent acts as an industry cushion and a balance wheel in helping companies meet their obligations. He's sometimes the answer to the integrated company's budget problem. Consider the major with higher exploration and drilling-development costs. Wells must be drilled this year if valuable leases are to be validated. Suppose refinery expansion is planned, but there isn't enough capital to do everything. His solution is to use the capital to meet drilling commitments now. He contracts with an independent to meet short-term or long-term market requirements. He'll deliver products to the major's specification and the major makes his money at the service station. When he gets out of the budgetary bind, he can expand his plant.

Individual success formulas . . . A few case histories will illustrate the success formula which some have used to cash in on opportunities in their areas.

One of the outstanding examples of the aggressive independent is Cosden Petroleum Corp., Big Spring, Tex., which has West Central Texas as its domain. Cosden likes to think of itself as a custom refiner. With a modern 30,000-bbl. plant to back up its sales force, Cosden has been able to supply major customers with a wide range of top-quality products blended to rigid specifications.

An alkylation and Rexforming unit put it in a good octane position. A Platformer producing aromatics has opened the way for its profitable solvent business. Availability of ethylbenzene from aromatics production led Cosden to go into the styrene business. It's the first producer of styrene to obtain the basic ethylbenzene by fractionation. Cosden has also developed a good business in specialty chemicals produced from petroleum fractions.

Another of the independent stalwarts is Eastern States Petroleum Co., which processes 65,000 bbl. of crude daily at two Houston plants. Eastern States took the jump into aromatics chemicals production when many companies, large and small, were doing little more than thinking about it. It scored a first in 1952 by installing the first Udex aromatics-extraction unit in its main refinery. Eastern States prides itself on shifting operations to meet the market situation. Let a tanker put in unexpectedly at Houston looking for a load of jet fuel, and before it can thread its way 60 miles upstream through the Houston Ship Channel, Eastern States will make a deal to supply the product.



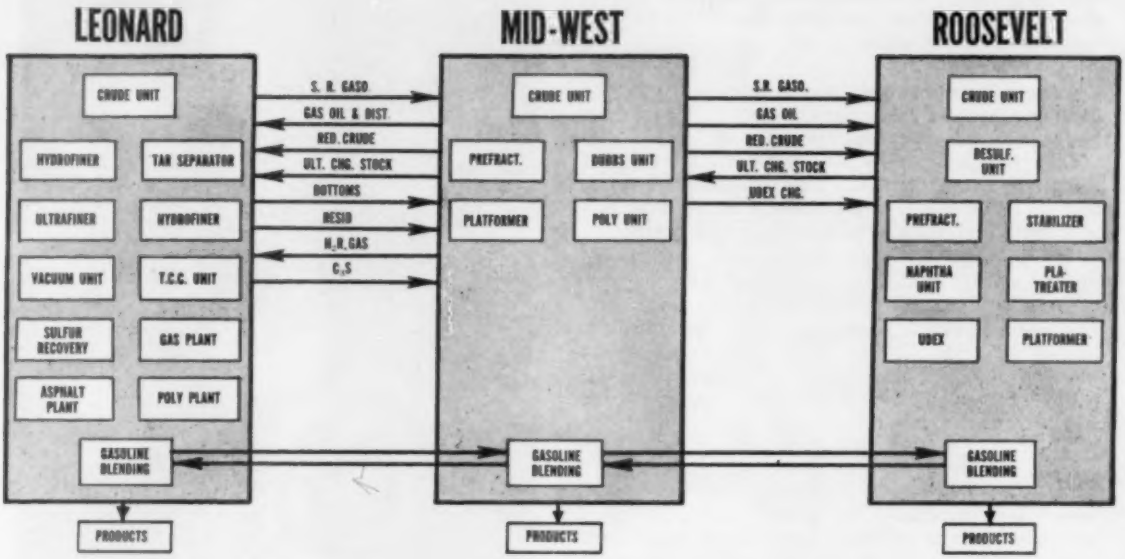
REXFORMING process has been answer of some small refiners to demand for 100-octane motor fuel. Independents took the lead in embracing this process.

It will shift operations to increase the jet-fuel yield while the tanker is still on its way.

Small plants compete . . . While the high cost of modernization has killed many small plants, independent and major alike, dozens of 5,000 and 10,000-bbl. refineries have met the challenge and remained in business. They have done so by taking advantage of scientific developments.

Probably the biggest contributor to the competitive health of the small plant was the catalytic reforming process. When the process came out in 1949, it became possible to upgrade low-octane naphtha stocks into high-octane, high-value reformate for blending into premium motor fuel. More important to the independent was the fact that cat reformers could be built in any size. The small refiner with only 500 bbl. of stock available is thus able to hold his own in the octane race. Significantly, the first reformer was placed on stream at an independent refinery—Old Dutch Refining Co., now Aurora Gasoline Co., Muskegon, Mich. Small refiners actually led the industry for a few years in catalytic reforming capacity.

Competition, hot as it is, hasn't kept newcomers off independent refining lists. About 4 years ago Suntide Refining Co. built its plant in the Corpus Christi area which was already heavily populated with



Why three small refiners merged

THE INDEPENDENT refiner today must remain competitive on product quality by installing and maintaining a wide variety of modern processes. And he must at the same time retain a flexibility which permits adjustment of product yields, to meet the best return in a market which reacts to seasonal and other fluctuations.

Three refineries in Central Michigan have shown a measure of success in meeting these requirements independently over a large number of years. And they saw a better way to operate and still maintain the "small, independent" classification. They merged so that each company might have access to the special processing facilities of all three. Leonard Refineries, Inc., of Alma; Mid-West Refineries, Inc., of Alma; and Roosevelt Oil & Refniing Corp., of Mount Pleasant; now operate under the Leonard name.

The merger has resulted in a new high level of economy, product quality, flexibility, and product diversification.

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independents. Suntide was successful with the original 25,000-bbl. plant and has grown rapidly to a 76,000-bbl. refiner, largest of all the independents. Suntide recently entered the aromatics chemicals field on completing new reforming facilities. Delhi-Taylor Oil Corp. has also established itself in Corpus Christi.

Another Corpus Christi independent, Pontiac Refining Corp., looked afield and saw Mississippi as a good spot for another plant. The company's affiliate, Pontiac Eastern Corp., has just placed on stream a new 15,500-bbl. plant near Hattiesburg. Texas Asphalt & Refining Co. recently started up a new asphalt plant at Houston capable of charging 7,500 bbl. daily of stock.

Old plants survive . . . Although the independent with the relatively large plant is having the most success, he isn't by himself in the field. Even the older plants which have not kept pace in the octane race are succeeding, primarily on specialty products. There are 99 U. S. plants without any catalytic processing and so can't compete with other refineries for gasoline octanes. Eighty of these plants are owned by independents. They make a business of manufacturing and selling asphalt, lubes, heavy fuel, jet fuel, and similar products. Pennsylvania has nine small plants processing Pennsylvania Grade crudes which are especially suitable for lube oils.

Some independent refiners hold their share of the market by maintaining their own outlets and marketing under their own brand names. Some build their own products lines to gain entry to new markets and compete with larger companies which have the advantage of pipeline transportation. They are aided by access to common-carrier pipelines providing an outlet to markets beyond their immediate refinery location.

The oil industry, through associations and societies, shares very freely the technological advances which are keys to progress in refining. When a new process is developed by a major company, it is made available to the industry under a license arrangement at a reasonable cost. Independents have the same technical know-how available in process design as the big company through such design-engineering contractors as Universal Oil Products Co.

The small refiner not only finds his place in a big industry where he fights an uphill battle, but, in competition with the giant majors, has made his place in many instances.

PIPELINING . . .

It belongs to refiners—large and small

TRANSPORTATION is tied in closely with refining. Almost every refiner in the United States, large or small, has some ownership interest in crude-oil and products pipelines, or both. This situation developed through refiners' concern for a guaranteed supply of their raw material and guaranteed distribution facilities for their finished products.

Small refiners who have found it advantageous to operate their own pipelines include Cosden, Suntide, Bell Oil & Gas Co., Shamrock Oil & Gas Corp., Derby Refining Co., Leonard Refineries, Inc., Champlin Oil & Refining Co., Frontier Refining Co., and others. Common-carrier crude and products lines find the big and small refiners in partnership in a single project where separate lines between the same points wouldn't be feasible. Producing interests may combine to build an outlet for a new field, but the usual pattern is for refiners to own the lines. "Outsiders" have found no logical place in the operating side of pipelining.

Exceptions to the rule against independently promoted pipelines are Oil Basin Pipeline Co. in Montana and Kaneb Pipe Line Co. in Kansas and Nebraska, both products systems. Onega Corp., Uniontown, Pa., is making a business of building short products lines to air bases. Railroads, taking advantage of their right-of-way, have become actively interested in pipelining. Their ventures could hardly be classed as small business, however.

Opportunities for ownership . . . Gathering systems have been the field where many small business men have found their place in pipelining. Every producing state has its local crude systems built by producers, refiners, or outside business interests to fill a local need. Where fields have no trunk pipeline connection, small trucking firms make a good business of hauling the crude to a refinery or pipeline. Some 6 per cent of all U. S. output is moved in this manner.

Coastal States Producing Co., Corpus Christi, is an example of a company which has specialized in gas-gathering systems to great advantage. And small gas markets attract small transmission and distribution firms. Carolina Pipeline Co. and North Carolina Natural Gas Corp. are building small gas lines. They will take gas from one of the nation's larger systems—Transcontinental Gas Pipe Line Corp.—and transport it across North and South Carolina.

Anyone who can get a supply and market together, line up capital, and prove public interest to the Federal Power Commission has a chance to build a profitable gas pipeline. But this field belongs almost entirely to the big man. For the cross-country gas lines which predominate in the industry cost many millions of dollars, often $100,000,000 to $400,000,000.

While gas pipelining, like some other phases of the oil industry, requires large sums of money, there is still opportunity. F. E. Stanley, Tulsa pipeline con-

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Their business is "pigs"

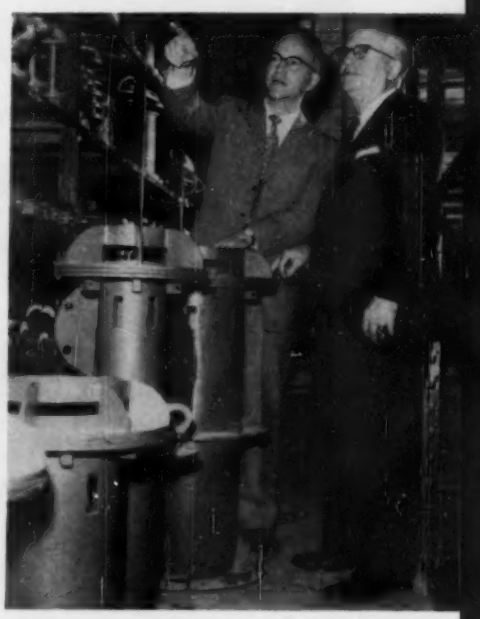
THE NEED for specialized equipment in pipelining has opened up many opportunities for small business. A good example of how this need can be capitalized on is the business which T. D. Williamson, Inc., has built around "pigs."

The firm is a three-way affair run by father and son, T. D., Sr., and T. D., Jr.—both of whom are electrical engineers. Mrs. T. D. Williamson, Sr., is treasurer. The Williamsons were manufacturers' representatives of electrical equipment for the oil industry before launching their present venture some 20 years ago.

The name "pig" belongs to the Williamsons. They design and manufacture the scraping devices for cleaning and testing petroleum and natural-gas pipelines. The pigs, which are warehoused, naturally, in a "pig pen," are the only mechanical means for increasing the hydraulic efficiency of a pipeline. Williamson engineers have made more than 600 types and sizes to serve a wide variety of pipeline needs.

The Williamsons with Hillco have served another specialized need by advances in the design of hot-tapping machines to cut branch openings in high-pressure "live" lines. Repairs and additions are possible, while flow continues through a temporary bypass, by using the "stopple," a plugging device invented by the Williamsons. The firm also is a leading maker of pipe insulators and bushings to provide insulation in road-crossing casings.

Their special equipment applies as well to water and steam lines and to piping for refineries and chemical plants.



AT RIGHT: The Williamsons, junior and senior in their "pig pen," sizing up the stock situation.

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Houston, Texas

H. T. HOPKINS
Kilgore, Texas

tractor, recently proved what can be done with an idea. He saw the possibilities of an industrial and residential market in semitropical Florida, and put over a $150,000,000 project to pipe gas from Texas to Louisiana. He succeeded where existing companies failed to see the opportunity, and got in ahead of others who had the idea but didn't push it until too late.

Contractors . . . The rapid growth of pipeline transportation, and the specialization which has grown out of a technical operation, has given the small business man his major role in pipelining. And that role is construction. About 35 years ago, pipeline companies handled most of their own construction. They maintained their own main-line spreads of equipment and men to do all their work. Now the practice is obsolete. The job has been delegated to some 160 pipeline contractors who have proved their ability to build lines and stations more economically. They have freed companies from the need to maintain a construction spread which may cost up to $2,000,000.

These contractors, almost all of them small business men, have created for themselves a permanent position in the industry. Last year they reported laying 28,000 miles of pipelines. Contractors handle the big-money end of the business. A company's plant is the pipe, which comprises the majority of the outlay for a project. The cost of laying the pipe—the sum the contractor is paid—amounts to about 30 per cent of the investment in the line itself.

Opportunities, operating methods . . . Several avenues are open to the pipeliner who wants to start his own business. One of the most common is for a construction superintendent of an existing contractor to get a contract on his own, form a company on the strength of it, borrow money for equipment, and he's in business. Another method is to start out in one phase of construction—stringing, cleanup, or the like—with the idea of expanding.

F. E. Stanley and C. C. Bledsoe, Tulsa, got Midwestern Constructors, Inc., on a firm footing building REA lines until they could put a pipeline spread together. H. C. Price, who concentrates entirely on laying big-inch pipe, started out in welding, the key operation in putting a pipeline together. Sammy Collins has built a thriving business on his special methods of laying pipe across rivers, lakes, and marshes along the Gulf Coast. R. H. Fulton started out as a company pipeliner and later worked for a contractor before organizing his own company. O. R. Burden retired from Texas Pipe Line Co., then engaged in drilling and pipeline construction. These are independent business men with a capital "I," who prosper by strong personal control of a very specialized operation.

Consultants . . . These specialists are more prominent than ever in pipelining. They are handling an increasing volume of design work which companies normally perform for themselves. They also provide the answer to foreign firms suddenly faced with the need for a pipeline without having any experience in the field.

Pipeline consultants, both individuals and small firms, offer a complete range of services from economic and route survey to preliminary and detailed engineering and construction management. Besides general consultants there are specialists in corrosion or particular phases of construction such as suspension bridges or marine crossings.

An elite group of small engineering firms sometimes handles important projects for such giants as Shell Oil Co. and Standard Oil Co. (N. J.).

Consulting has proved a rewarding field for many top pipeliners who retired or who gained operating experience and desired to organize their own businesses.

Specialized equipment . . . The field of specialized construction equipment and machines is another place occupied almost solely by the independent small business man. Where pipeline companies had not the inclination, time, or incentive to develop tools for specific construction needs, manufacturers with inventiveness stepped in to fill the void.

Little giants in this field are Crutcher-Rolfs-Cummings, Inc., Perrault Equipment Co., and M. J. Crose Manufacturing Co. They build the coating and wrapping machines, the cleaning machines, the lineup clamps which are so essential in laying modern big-inch lines. T. D. Williamson, Inc., built up a good business based mainly on pigs—the scrapers which keep pipelines clean.

MARKETING—little man prevails

COMPETITION reaches its peak in the market place, and it is here also that the partnership of big and small business has been developed most fully. This branch of the oil business involves more people than any other. There are some 200,000 small business men operating retail service stations, and a like number operating retail outlets which sell gasoline as an adjunct to the main product or service. There are 16,000 jobbers and distributors operating bulk plants and truck fleets handling gasoline and fuel oil.

When a motorist fills up at the service-station pump, he probably believes the operator who serves him is an employe of the company whose brand is sold. This is more often untrue than true. In fact, 19 out of 20 retail stations are operated by dealers in business for themselves, according to an American Petroleum Institute study.

Gasoline travels from the refinery to the automobile fuel tank in a variety of ways. It may come directly from the major or independent refiner to the supplier-owned station. It may come directly from the refiner to an independent service-station dealer. Or it may come from the refiner through a wholesaler (branded or unbranded distributor) who resells to an independent dealer or distributes through his own outlets.

Most stations are operated by dealers who own the station or by dealers who lease the station from the owner-supplier. In either case, the dealer is surely in business for himself. He pays for his inventory, sets his own prices, keeps his records, hires personnel, and decides by his own management whether he will make a profit.

Stations also are operated by a consignee who sells

He chose marketing

TIMES WERE HARD and money was tight back in 1935 when L. E. (Moose) Davis first decided to go into business as a service-station operator. There were times, during his beginning venture, when he could only pay for 200 gal. of gasoline at one delivery.

Today, Davis has a TBA (tires, batteries, accessories) volume, alone, of approximately a quarter of a million dollars annually.

His small, old-fashioned station of 1935 has grown into a large "service center" with five large service bays; a large, modern sales room; and a restaurant. In addition, he now owns one of the most modern and largest recapping plants in the Midwest. His trucks travel Oklahoma, Kansas, Missouri, Iowa, and Nebraska.

Davis, a D-X Sunray Oil Co. lessee in St. Joseph, Mo., admittedly is not a "typical" independent businessman in the marketing end of the oil business. Nonetheless, there are thousands of men around the country who have enjoyed similar if less spectacular success.

on a commission or by a salaried employe of the station owner. But the station operated by the refiner nowadays is a rarity. Such stations are operated primarily for experimental or training purposes and not as major retail outlets for the company's products.

The branded distributor, like the dealer, buys and sells at his own risk. He has all the opportunities and risks of the small business man in other fields.

Partnership . . . It is easy to see that the success of the refinery supplier is bound up with the success of the independent dealer. Each is indispensable to the other. Each works to weld the partnership more closely together.

The refiner, independent or major, in order to spur sales of his product, generally aids the dealer in every way possible. He shows him how much help he likely needs to do a certain volume of business. He shows him what kind of men are likely to be the best for the job and how to hire them, train them, and gain their help in building business through bonuses or other incentive plans. The supplier will set up a records system so that the dealer gets a true picture of his financial situation. He will advise him on management of money and inventories and offer a guide to check expenses and keep credit in balance.

Tips to the dealer will spotlight hidden losses, open up creative-selling opportunities, suggest merchandising plans, coordinate promotion with the supplier's brand advertising, and lay out complete ad campaigns—all designed to increase business which is beneficial to both. The supplier offers aid to all his dealers and winds up competing against himself.

Competition . . . The independent dealer handling well-known name brands runs into sharp price competition with other independent dealers selling "unbranded gasoline" or the lesser-known brands. These usually sell for 1 to 3 cents below most majors.

"Unbranded gasoline" may come from a variety of sources. It may have been "branded gasoline" produced by a major refiner who found himself with surplus stock above his contract requirements. This gasoline loses its name when it goes on the spot market and is sold through a broker, who is another small business man and a key factor in spot sales.

Fuel-oil distributors . . . Independent distributors have played a major role not only in retail sales of fuel oil, but in developing the market as well.

They have pioneered in automatic deliveries, marketing of burner parts, and other aspects of the business. Integrated companies rely on them almost entirely for heating-oil sales. The independent distributor handles more than 80 per cent of all heating oil sold in the United States.

Opportunity . . . As demand for petroleum products has grown, so has the opportunity for the small business man. The opportunity is still there. In marketing, the demand for good dealers exceeds the supply. This branch of the oil business is the easiest of all to enter. It is open to anyone with a little capital, a good credit rating to obtain stock, and the business sense to manage a small enterprise. There are no closed doors to the ambitious and resourceful in this or any other branch of the oil industry.

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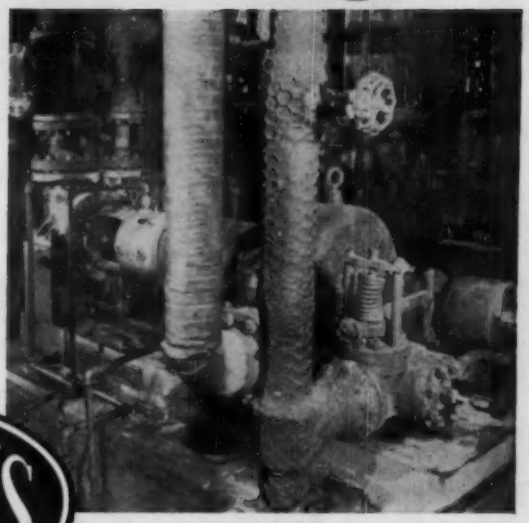

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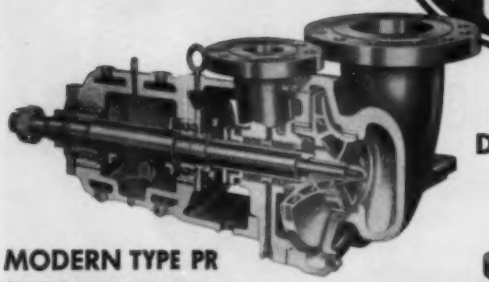

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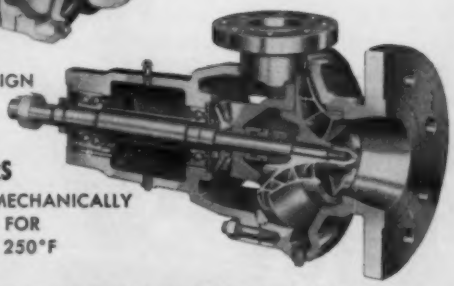

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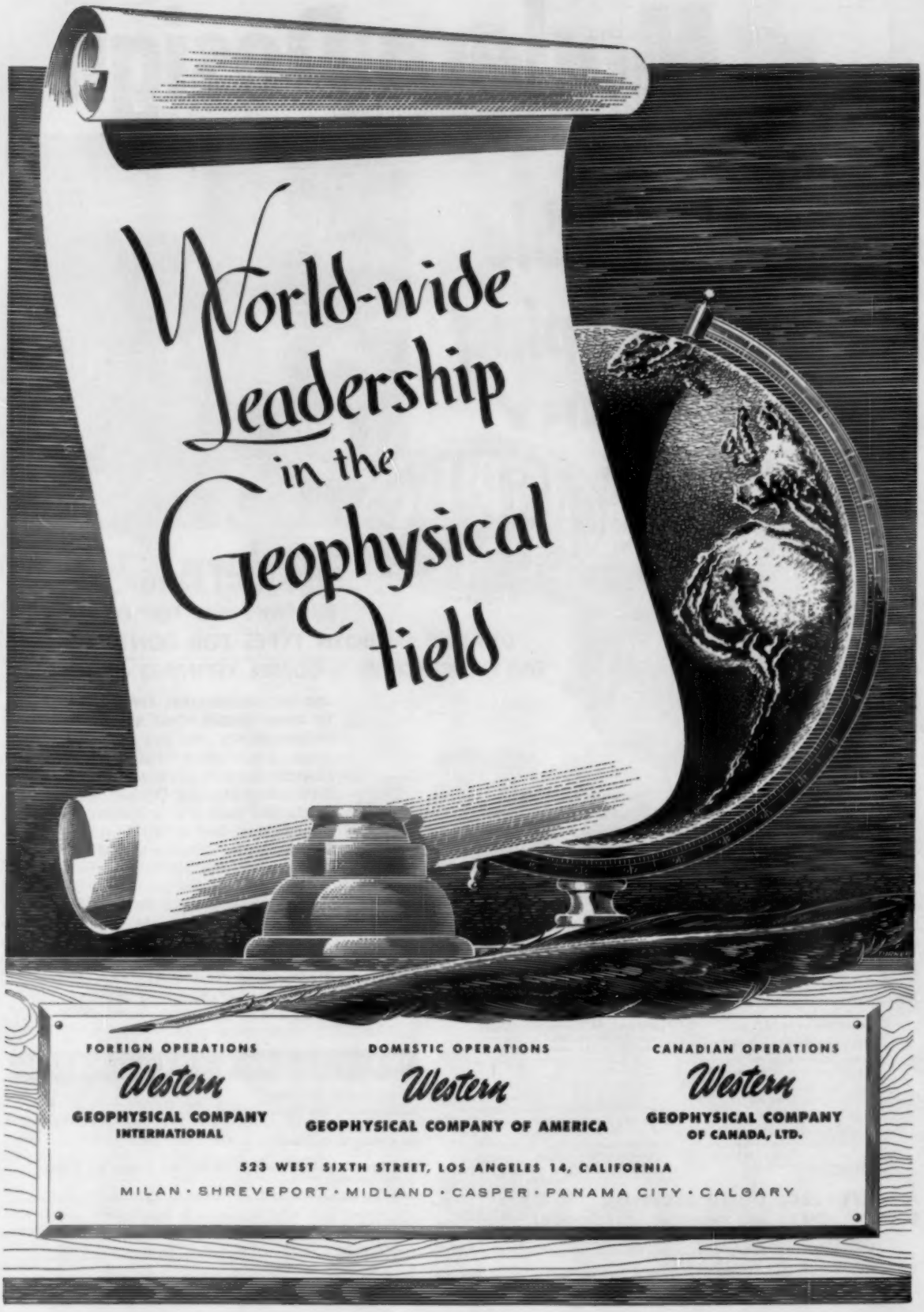

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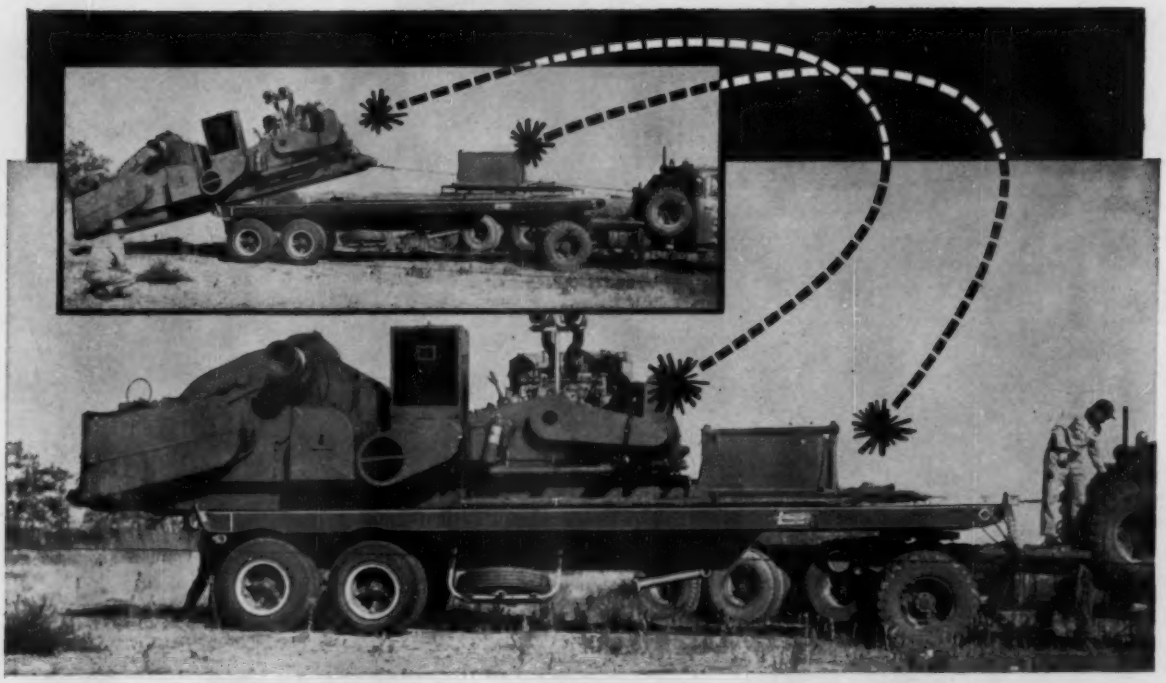

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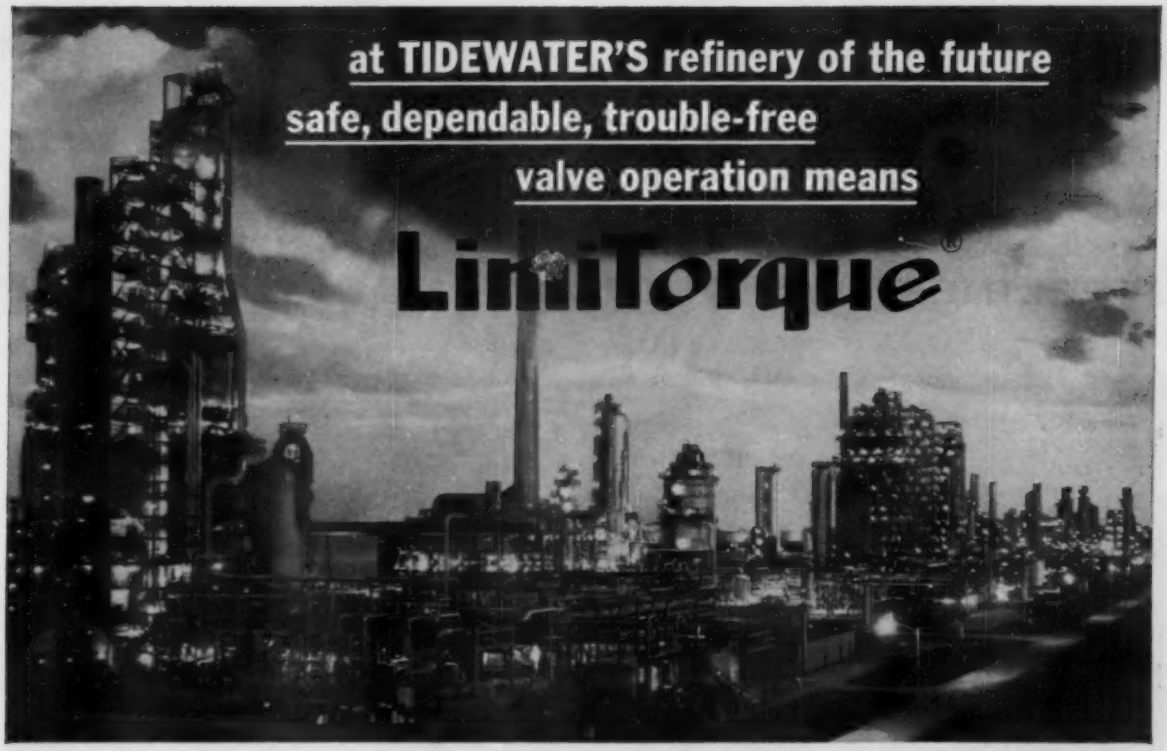
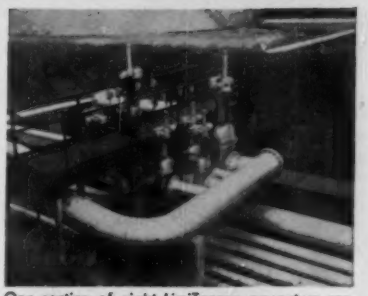


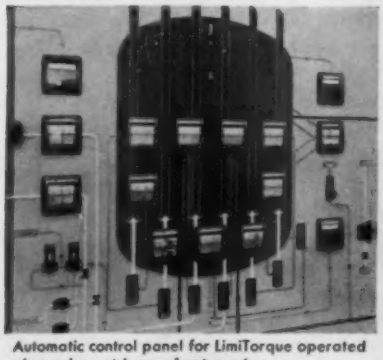
Here, at the World's newest and finest refinery where equipment standards are high . . . technology far advanced . . . six LimiTorque type S3 valve operators at the base of the big "cat", recycle catalysts around the clock . . . help maintain throughput capacity of 102,000 BPD.

In fact, in the refinery section alone 134 LimiTorque Motorized Controls provide safe, automatic, trouble-free valve operation. LimiTorque is more than proud to have played a part in this tribute to American ingenuity.

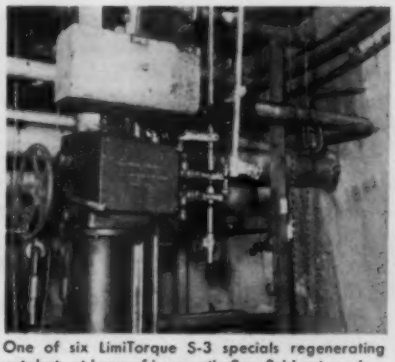
Wherever automatic, remote valve operation is required, LimiTorque will provide rapid, precise control under a wide range of operating conditions. Actuated by electricity, hydraulic pressure, air, or high pressure gas, LimiTorque can be readily field mounted on existing valves. For specific applications, contact your valve manufacturer or nearest LimiTorque representative.



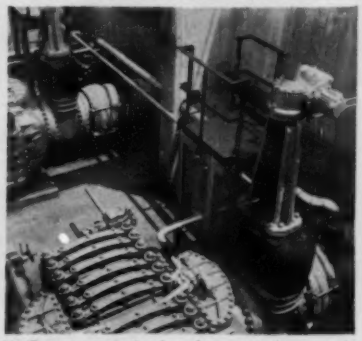
One section of eight LimiTorque operators controlling flow of crude oil to and from tank farm.



Automatic control panel for LimiTorque operated plug valves at base of cat cracker.



One of six LimiTorque S-3 specials regenerating catalysts at base of huge orthoflow fluid cat cracker.



LimiTorque motorized valve controls operate 36 in. valves on ten giant twin strainers.

LimiTorque®

PHILADELPHIA GEAR WORKS, INC.

ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.

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INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

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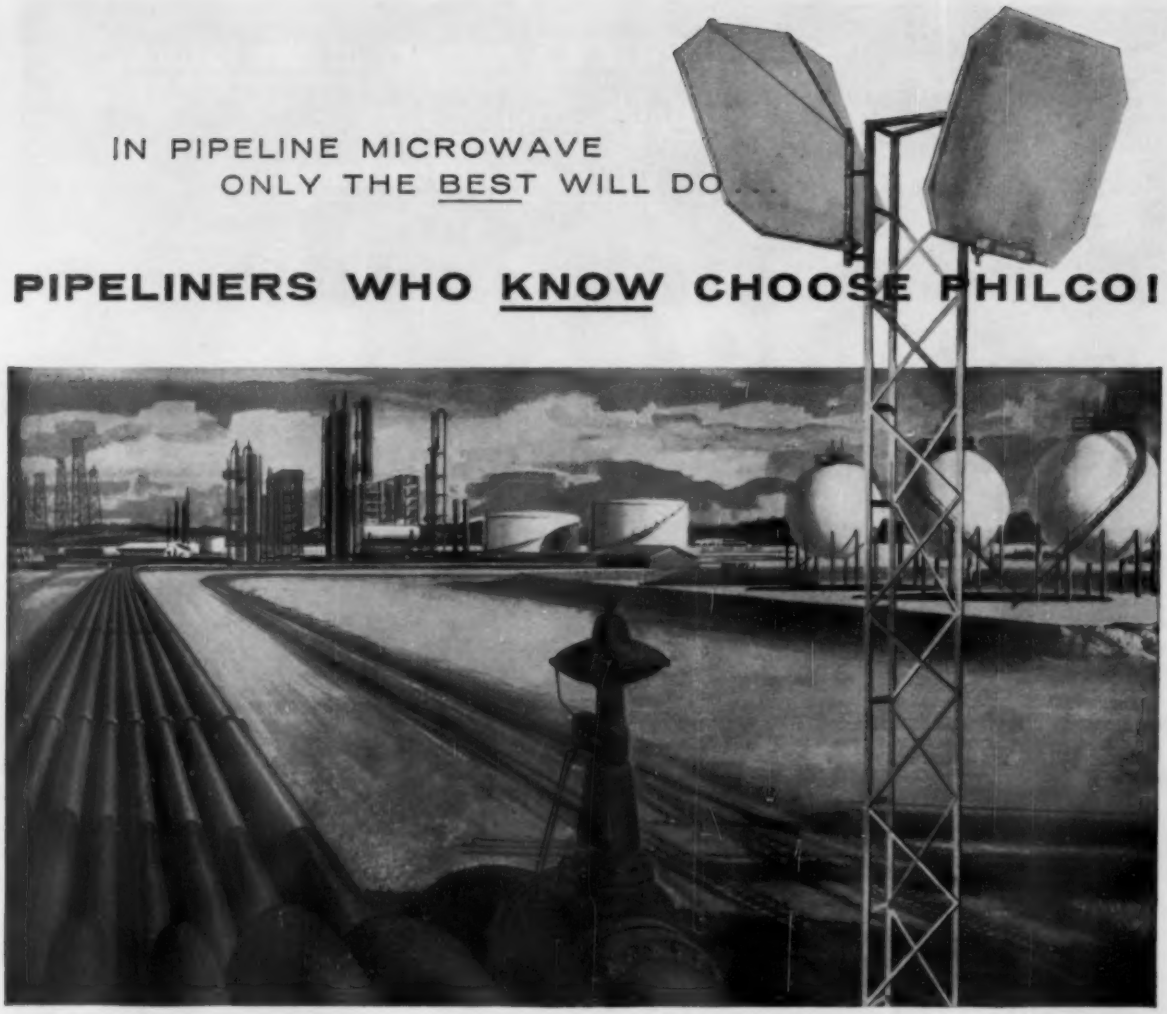
IN PIPELINE MICROWAVE
ONLY THE BEST WILL DO...

PIPELINERS WHO KNOW CHOOSE PHILCO!



Philco Microwave Delivers Outstanding System Reliability, Economy of Installation and Operation, Simplified Equipment Maintenance!

Philco microwave is proving itself in a growing number of pipeline applications. With 240 channel baseband capacity for telephone, telemetering and remote control—including reserve capacity for high-speed computer data transmission—Philco microwave fills both immediate and long-range requirements of modern pipeliners.

Semiconductor rectifiers replace conventional tubes in the new Philco heavy duty tubeless power supplies, assuring minimum maintenance and significant reductions in operating costs. Printed wiring panels increase circuit stability, simplify field maintenance. Klystrons are cooled by convection—compact heat sinks eliminate the need for bulky blowers.

Here is reliability of performance unaffected by severe weather, free from the many limitations of wire and pole line construction, unhampered by problems of difficult terrain, over-water transmission or expensive rights-of-way.

Philco engineers will be happy to help with your special microwave requirements. Please contact us for further information. Look ahead . . . and you'll choose PHILCO.

PHILCO®

Government & Industrial Division
Philadelphia 44, Pennsylvania
In Canada: Philco Corporation of Canada Limited, Don Mills, Ontario

BOTH ARE Fibercast® WELL TUBING ONE IS NEW...THE OTHER WAS IN A SALT WATER DISPOSAL WELL FOR 17 MONTHS!

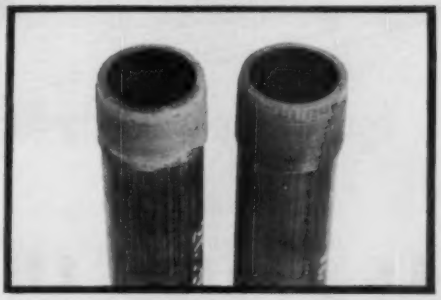
You can't tell the difference— because Fibercast® will not corrode

Anyone who has pulled a string of tubing after several months and found it corroded beyond practical use will truly be impressed with *this actual experience*. The length of Fibercast on the left above was in a salt water disposal well for 17 months... the one on the right is new. Yet, because Fibercast is unaffected by corrosion-causing elements, there is no noticeable — and, more important, *measurable* — difference.

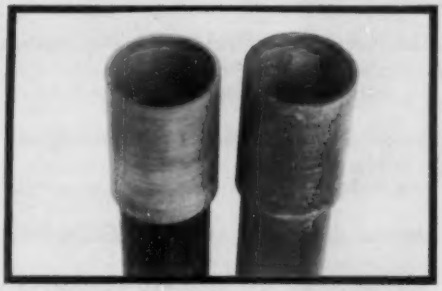
Corrosion eats away dollars as well as the pipe; that is, most pipe... but not Fibercast, because "Fibercast *will not* corrode." Too, Fibercast has other greatly desired advantages... high operating temperatures and pressures... lightness... and long-term economy. Send the coupon for complete details.

You get the same desired qualities in Fibercast Line Pipe — for gathering lines... tank hook-ups... all refinery and chemical plant installations where corrosion is a problem.

All photos are unretouched



The tubing on the left above is new — the other was in a salt water well for 17 months.



There's no noticeable nor measurable difference between the new coupling on the left and the one that was in salt water for 17 months!

THE FIBERCAST CORPORATION
Sand Springs, Oklahoma
A Subsidiary of The Youngstown Sheet and Tube Company

CONTINENTAL-EMSCO COMPANY
A Division of The Youngstown Sheet and Tube Company
General Offices: Dallas, Texas
Export Division: 45 Rockefeller Plaza, New York, N. Y.
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General Offices: Calgary, Alberta, Canada
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Representatives in All Principal Oil Fields of the World

CONTINENTAL-EMSCO
Serving the Oil and Gas Industries ... Worldwide

CONTINENTAL-EMSCO COMPANY
P. O. Box 359, Dallas, Texas

Send information on Fibercast Well Tubing and Line Pipe.

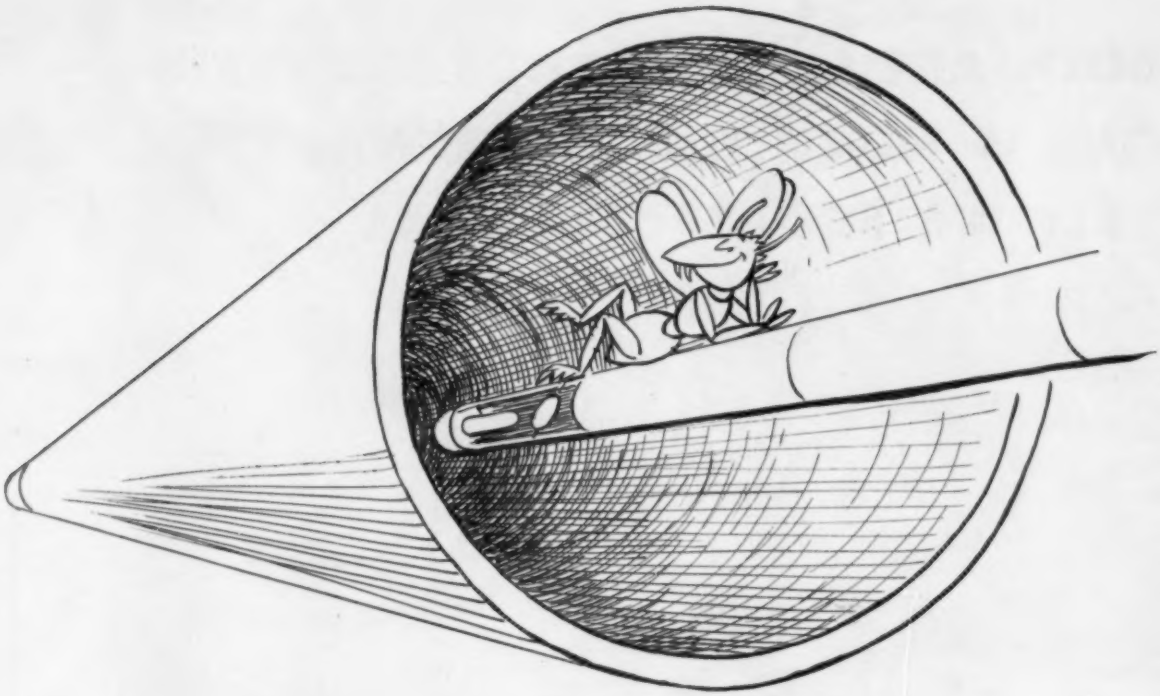
Name_____

Title_____

Company_____

Address_____

City_____ Zone____ State_____



IS YOUR INSPECTION SERVICE MISSING SOMETHING?

Seriously, many a dangerous "bug" escapes ordinary inspection techniques. Plastic Applicators' inspection procedure—after descaling, degreasing and sand blasting to bare metal—repeatedly has turned up hidden defects exceeding API specifications in previously field-inspected and approved tubular goods.

Plasticap offers you a choice of optical and magnetic inspection and hydrostatic testing. All joints are tested with API drift for diameter and straightness; upset areas on grades above N-80 are blasted to white metal. Materials to be coated are handled only once and may be stored in our yard until required.

You save time and get a *closer* look at no additional expense when you use Plastic Applicators' superior inspection services.

Plastic Applicators, Inc.

TUBULAR GOODS INSPECTION SERVICES
BAKED-ON PLASTIC COATINGS

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Now... at 1/10 the cost... a better

ANTI-STALLING ADDITIVE

GULF AGENT 178

... proved by over 25 billion miles of stall-free driving!

GULF AGENT 178 provides economic, effective anti-stalling performance in motor gasolines. At the same time, it affords corrosion protection at no extra cost.

Look at what GULF AGENT 178 offers you:

PROVED PERFORMANCE—GULF AGENT 178—long recognized as an outstanding corrosion inhibitor for all types of petroleum products—is now used by major refiners in modern volatile motor gasolines to eliminate stalling caused by carburetor icing . . . and its effectiveness for this use has been proved in service by over 25 billion miles of stall-free driving.

LOW COST—Small concentrations—15 to 25 pounds per thousand barrels—give anti-stalling protection at as low as 1/10 the cost of commonly used de-icing additives.

EASE OF USE—GULF AGENT 178 is readily soluble in all petroleum products—can be easily blended at temperatures ranging from minus 30 to plus 140° F. Also, it is insoluble in water and can be handled in conventional gasoline transfer systems with no danger of loss from water leaching.

MINIMUM STORAGE—The small concentrations required eliminate need for expensive additive storage.

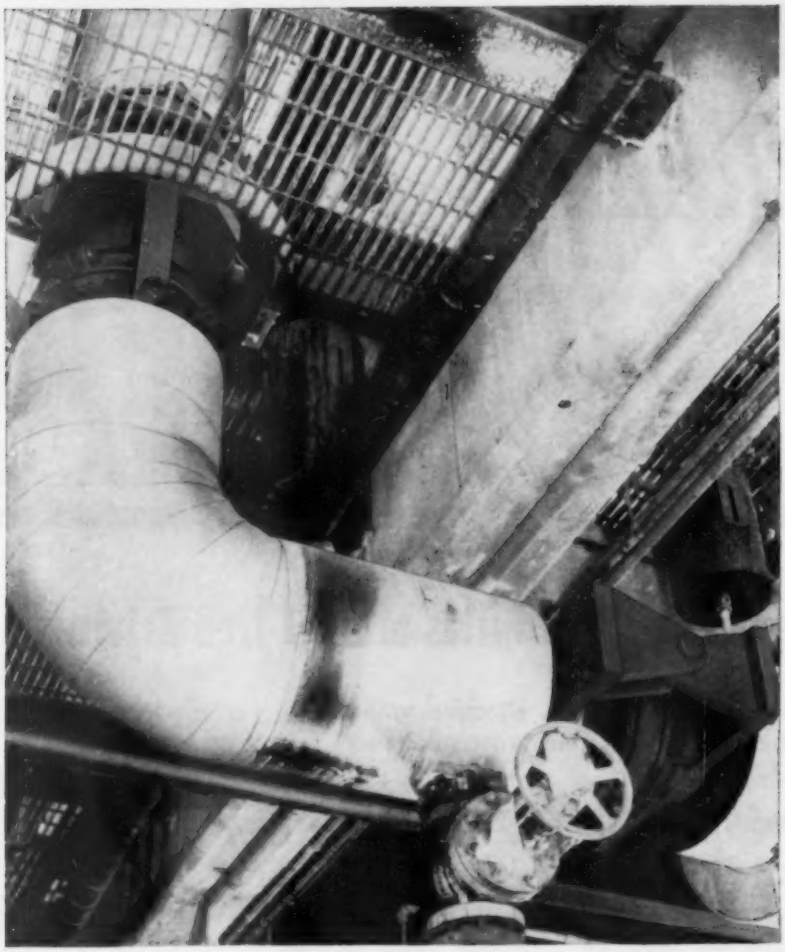
EXTRA BENEFITS—Rust protection it provides lengthens life of distribution and storage facilities from refinery to customer.

Let us demonstrate GULF AGENT 178 in your gasoline!

Petrochemicals Department
GULF OIL CORPORATION
Gulf Building
Pittsburgh 30, Pennsylvania

QUALITY CHEMICALS *from* PETROLEUM

GULF®



THIS IS WHAT ADSCO MEANS BY SPECIAL JOINTS

The photo shows a small but very important section of an insulated, spring-suspended 8" pipe line in the new Moundsville, W. Va., plant of the National Aniline Division of Allied Chemical & Dye Corp. At the point shown, the line is subjected to complex stresses which are completely resolved and placed in balance by the ADSCO Gimbal Expansion Joint, upper left, and the ADSCO Hinge Expansion Joint, lower right.

In the Gimbal Joint, two sets of bars are pinned to the octagonal ring at 90° to each other. The other ends of the bars, still at 90° to each other, are pinned to the pipe leading into the joint. Running through the center of the ring, with a slight clearance, is a nipple connecting two expansion elements. This gimbal arrangement permits the joint to absorb 6° of angular movement from two different directions: the left and right motion of the horizontal part of the ell and similar motion from other unseen upper horizontal piping at 90° to the plane of the lower piping.

A partner to the Gimbal Joint and an indispensable part of this piping system is the Hinge Joint shown lower right. This absorbs the angular rotation of the ell caused by the expansion and contraction of the vertical piping.

There are so many motions involved in this section that, under certain conditions, the octagonal ring of the Gimbal Joint could describe a circle. Yet ADSCO and National Aniline engineers were able to identify all the motions and absorb them economically and efficiently by the Gimbal and Hinge Joints.

ADSCO designs and manufactures many types of both standard and special joints for many purposes. Consult ADSCO on any piping problem.

ADSCO DIVISION
YUBA CONSOLIDATED INDUSTRIES, INC.
20 MILBURN ST. BUFFALO 12, N. Y.

BEFORE RODINE was adopted. Note the complete breakdown of the walls of the down-well tubing and casing.

AFTER RODINE was put to use. Though the well is highly acidic, little corrosion of the tubing and casing occurs now.

ACP Rodine® INHIBITS CORROSION IN SWEET WELLS, CONDENSATE WELLS, AND SECONDARY RECOVERY OPERATIONS—COSTS ONLY PENNIES A DAY

For just a few pennies a day you can minimize corrosion that costs you thousands of dollars annually. ACP Rodine will inhibit corrosion, cut maintenance and replacement costs, help prevent loss of production. It is readily soluble in water and brine, is effective over 200°F, can be added to the well by slugging (since it is heavier than the crude, it rapidly sinks into the water layer at the bottom of the well), or by proportioning pumps. And it does not promote or stabilize emulsion.

Specify whether your corrosion problem is in sweet wells, condensate wells, or secondary recovery operations. We'll send technical data and samples. Or our field engineering staff will cooperate with you in corrosion studies, including coupon service and fluid analysis.

AMERICAN CHEMICAL PAINT COMPANY, Ambler 39, Pa.

CHEMICALS ACP PROCESSES

DETROIT, MICH. • ST. JOSEPH, MO. • NILES, CALIF. • WINDSOR, ONT.

New Chemical Horizons for Industry and Agriculture

for only a few cents a day, **COREXIT** will give you up to **98%** protection against internal corrosion

Humble's COREXIT corrosion inhibitors effectively and economically prevent internal corrosion in refineries. Injected into the product stream, COREXIT establishes a protective film on metal surfaces, assuring up to 98% protection against the causes of internal corrosion. Thus it lengthens the life of expensive equipment and prolongs refinery runs between costly turn-arounds.

COREXIT also prevents fouling and promotes increased thermal efficiencies. You can save time and money by including COREXIT in your program for corrosion prevention in the refinery.

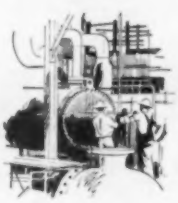
Without cost or obligation, Humble's Technical Service engineers will assist you in solving your corrosion problems. For engineering service and complete information on COREXIT, phone or write:

Humble Oil & Refining Company — Sales Technical Service
P. O. Box 2180, Houston 1, Texas

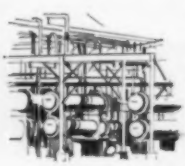
Experience proves that COREXIT prevents up to 98% of internal corrosion in —

Crude unit overhead systems

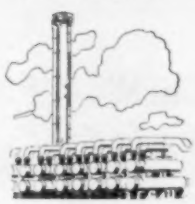
Sour crude naphtha rerun units



Pre-heat trains to crude units



Fractionation tower overhead systems



HUMBLE

on the "scorpion"...

the Rotary Hose is

Thermoid

POWERFLEX

The patented full flow coupling at the left is just one reason why the Scorpion is equipped with Thermoid Powerflex Rotary Hose. It's an integral part of the cable assembly—cannot leak or pull off. The cable itself is made up of *33 miles of high tensile steel-wire* wrapped and counter wrapped. And the tube and cover of Powerflex Hose are made with oil and abrasion resistant Neoprene, reinforced with impregnated multi-ply woven fabric.

You'll also find Thermoid Suction and Discharge Hose and Thermoid Multi-V Belts "aboard" the Scorpion for the same reason—superior quality construction. Order Thermoid Oil Field Products from your nearest supply store or Thermoid warehouse.

Thermoid

THERMOID COMPANY, TRENTON, NEW JERSEY, NEPHI, UTAH
Warehouses: HOUSTON, OKLAHOMA CITY, ST. LOUIS, CASPER, LOS ANGELES

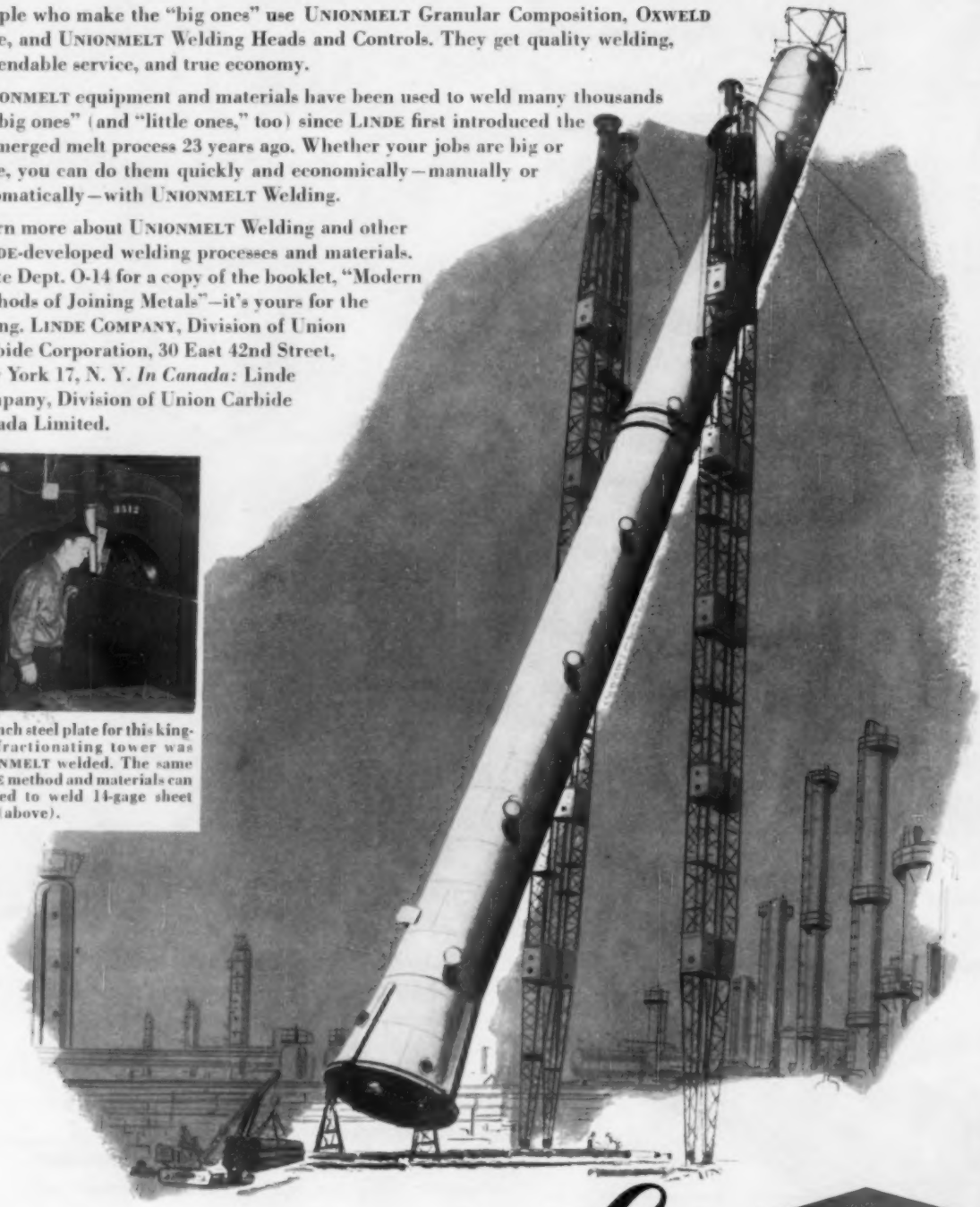
UNIONMELT Welding
makes short work of tall towers

People who make the "big ones" use UNIONMELT Granular Composition, OXWELD Wire, and UNIONMELT Welding Heads and Controls. They get quality welding, dependable service, and true economy.

UNIONMELT equipment and materials have been used to weld many thousands of "big ones" (and "little ones," too) since LINDE first introduced the submerged melt process 23 years ago. Whether your jobs are big or little, you can do them quickly and economically—manually or automatically—with UNIONMELT Welding.

Learn more about UNIONMELT Welding and other LINDE-developed welding processes and materials. Write Dept. O-14 for a copy of the booklet, "Modern Methods of Joining Metals"—it's yours for the asking. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited.

One-inch steel plate for this king-size fractionating tower was UNIONMELT welded. The same LINDE method and materials can be used to weld 14-gage sheet steel (above).



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UNION CARBIDE

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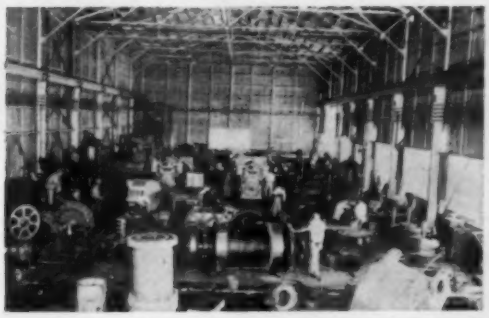
a new high in prompt service . . .

from AVONDALE



For speedier customer contacts throughout the oil country . . . Avondale now has available a 265 h.p. Helio-Courier seaplane for Sales and Service coverage. This means a new high in Avondale's "prompt service" tradition. We are prepared, as always, to meet your most exacting requirements on construction and repair of oil drilling equipment. Our entire integrated facilities, including our Oil Tool Department and modern Electric Shops, are at your disposal . . . 24 hours of every day.

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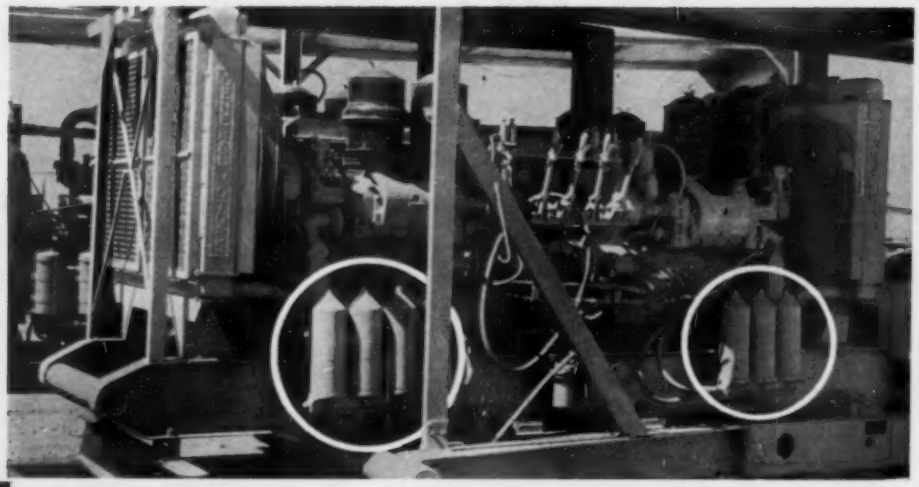


WINSLOW
Full-Flow
FILTERS

Case History Report No. 37 Shows Why Engines Protected by WINSLOW FILTERS Last Longer

LUBE OIL KEPT CLEAN A MONTH INSTEAD OF A WEEK *with Winslow CP* Filters*

Laughlin & Porter Co. of Odessa, Texas, one of the largest Texas oil drilling companies, operates many drill rigs. Power for some electric generators is supplied by a quad installation of four 6-71 GM engines. The engines run 24 hours a day—a real tough test on lube oil—on filters and on engines.

With original filter equipment, oil and element changes were made every week. Since the installation of WINSLOW B-74 Full-Flow Filters, with CP* elements, oil and elements are changed only once a month or after 720 operating hours.

That's important in operating costs, and other big savings are longer engine life and lower maintenance cost, with the use of Winslow Filters. Ask about the application of modern CP* filters for all your powered equipment.

CP* FILTRATION

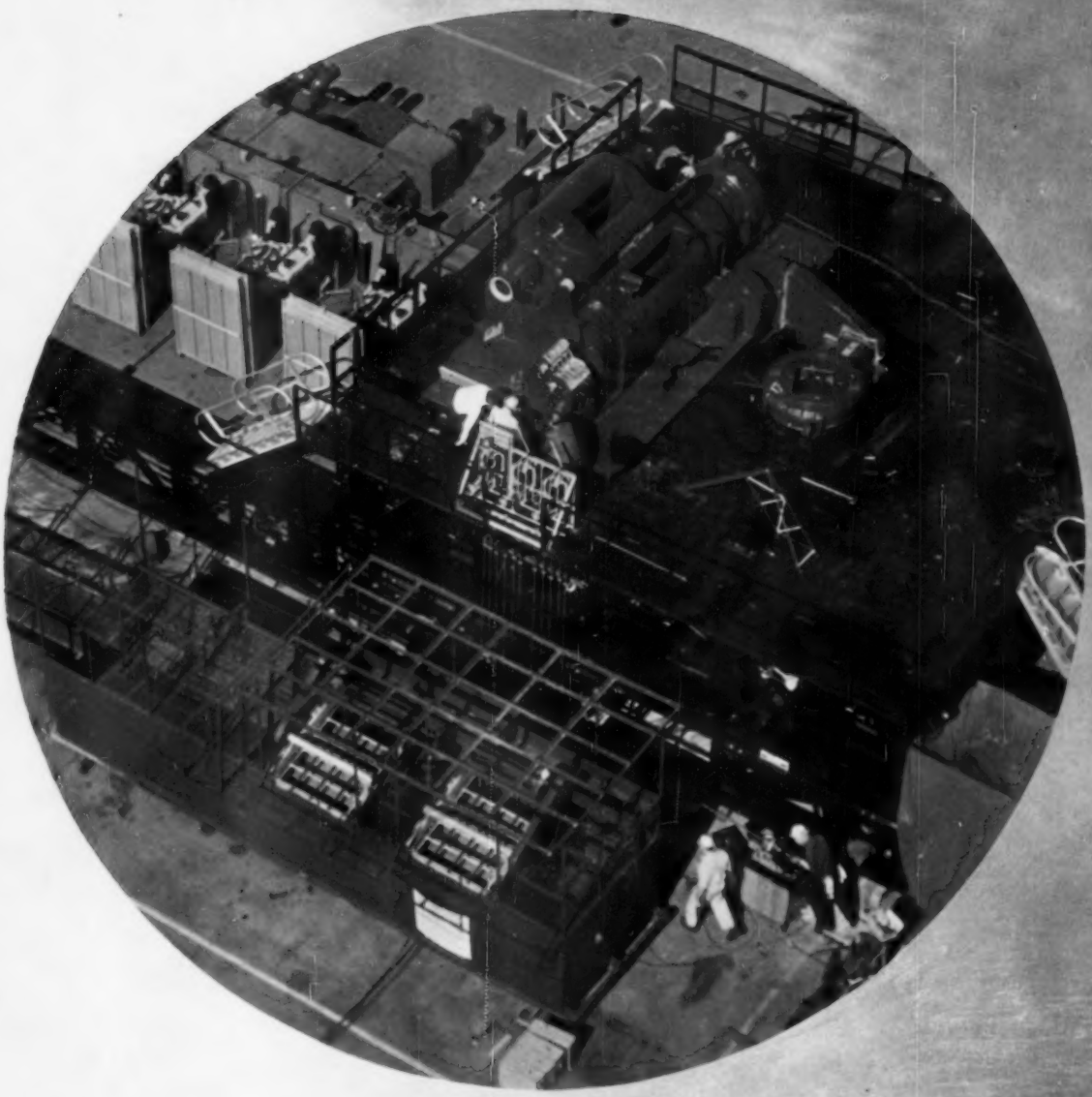
Winslow patented CP* (Controlled Pressure) elements are designed to continuously self-adjust the pressure within the filter and allow for a full stream of filtered oil without opening by-pass valves. This is accomplished through the dual flow capacity, with two types of material in the same element.

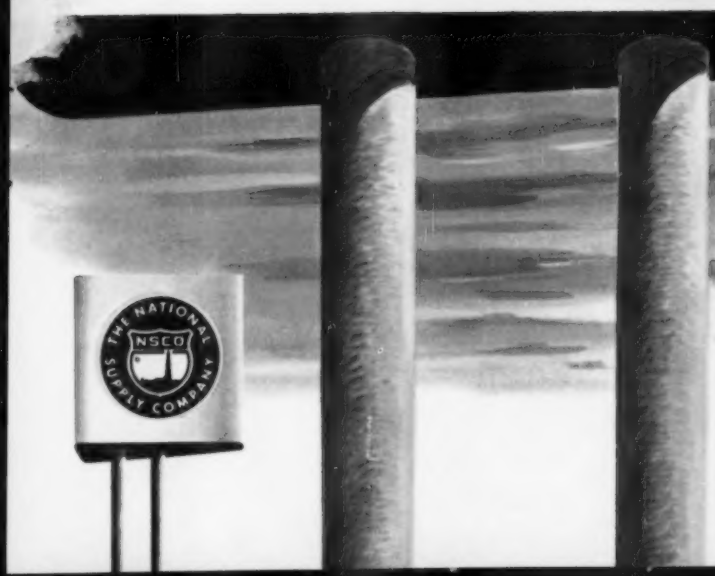
**CP is fully protected by patents and trademarks*

WINSLOW **ENGINEERING & MANUFACTURING COMPANY**

4069 Hollis Street, Oakland, California

W-2593-A





Another "Blue Iron" rig-up for Africa's Gold Coast

This is one of two Type 80-B National Rigs being pre-assembled and tested at our Torrance, California plant for service in Nigeria on the African Gold Coast. This preparation for most of our rigs going abroad and for

Continued on next page

Especially useful for larger rigs, National's optional rig-up service insures that every operating detail is anticipated.

Continued from previous page

many of our rigs destined for domestic service has a special name at National Supply. We call it *rig-up service*—and it has prevented many problems and saved time for contractors.

Here is how it works: At a National plant, store or your own equipment yard, we assemble—or direct the assembly of —the complete rig. Then, it is test-operated, lubricated and adjusted. If additional companion equipment or services are required, they are furnished *immediately*. Any problems that may delay you are promptly solved. Guide photos and paint-coded parts for fast re-assembly are supplied if you want them.

You can see how this rig-up service pays off in operations half-way around the world where service and parts are often days away. But it is becoming more important in domestic operations, too—when every day's delay plays havoc with estimated operating costs.

There's no doubt about the worth of preliminary rig-up service. Customers who use such National test-assembled rigs report *better rig-up time than previous field assemblies*.

This optional rig-up service is worth considering on any National rig shown on these pages. For either domestic or overseas operations, it can be the best insurance you ever bought. The National representative in your area, or National's Export Division office will be glad to give you complete details.

This is a portion of the rig assembly line at National Supply's Torrance, California, plant. National also manufactures smaller rigs at Toledo, Ohio.

Offshore? Deep drilling? Workover or servicing?

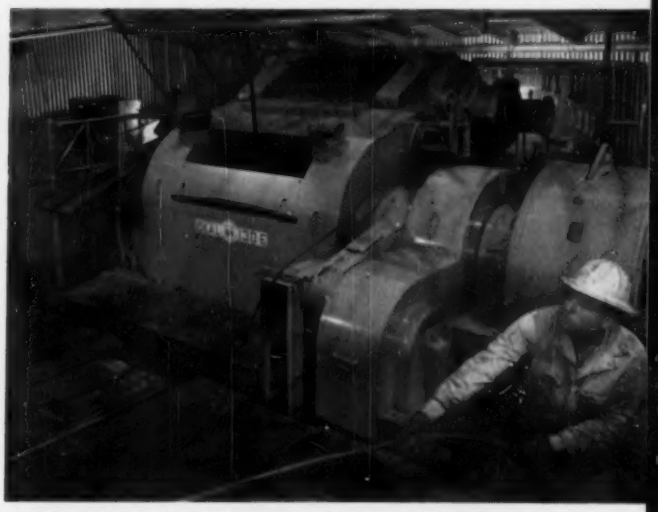
National rigs have extra performance built-in for every job

You can operate a National Rig in any land or water-based location and count on low-cost footage. You can drill shallow or deep, in hard or soft formations, and count on smooth-running action. And many of our customers believe that a National Rig is an asset in their contract negotiations.

What's behind all these advantages? Simply, top design and quality materials. Years of close association with your drilling problems insure correct, modern design. In manufacturing and assembly, the best materials and latest techniques are used. There's great attention to hundreds of construction details that can be all-important on a fast drilling schedule. In every way, extra performance is built into National Rigs. If you need application advice or service on location, you'll get it promptly from National—the world's largest supplier of oilfield machinery and equipment.

Before your next job, check on the operating economy of National Rigs. Ask the National Supply Store or representative in your area for complete details.

National's complete line of 10 rigs serves every drilling range—from the shallowest to the world's deepest wells. For truck or trailer mounted operations, the following National Rigs are available: T-8, T-8-S, T-12, T-12-S, T-20, T-20-S, T-32—in a range of horsepower from 80 to 320. For medium to deep drilling (on land or offshore), these National Rigs are available:



Type 55, 80-B, 110, 130 (an electric model is shown above), 160—in a range of horsepower from 550 to 2,000. Be sure to ask your local National Supply Store or Representative for complete information and descriptive bulletins on these top performers—proved in service throughout the world.

THE **NATIONAL SUPPLY** COMPANY

MAIN OFFICE: Two Gateway Center, Pittsburgh 22, Pa.
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NATIONAL BLUE OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE AND ELECTRICAL CONDUIT

If you want top performance on truck or trailer-mounted equipment, see the next page...

A National T-32 trailer rig on location in Mississippi. National Rigs and Hoists utilize torque converter drives for smooth operation and a great variety of running speeds.

"Minimum downtime – faster operations"

. . . that's what operators say about National trailer-mounted rigs and truck-mounted hoists

You will, too, if you use these rugged smaller rigs! You'll get the same quality design features and construction you find in big National Rigs—the quality that insures top performance.

Mounted to suit your requirements, these National Rigs are exceptionally fast on rigs-ups and tear-downs. Their compact, *packaged* construction permits quick movement—and helps keep between-job downtime to a minimum.

Get all the facts now on portable National Rigs. There are four types—enough to meet every rig need in the trailer or truck-mounted horsepower range. Ask the National representative in your area for descriptive bulletins and performance records.

THE **NATIONAL SUPPLY** COMPANY

MAIN OFFICE: Two Gateway Center, Pittsburgh 22, Pa.
DIVISION OFFICES: Denver; Fort Worth; Houston; Toledo; Tulsa; Torrance
CANADA: The National Supply Company, Ltd., 200 F. W. Clark Building, 709 Eighth Avenue, West, Calgary, Alberta
EXPORT: 600 Fifth Avenue, New York 20, N.Y., U.S.A.; City Wall House, Chiswell Street, London E. C. 1
NATIONAL BLUE OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE AND ELECTRICAL CONDUIT

BIG GUN IN STAINLESS

Stainless steel so effectively turns the battle against corrosion that there is no question about the investment payout. To assure long life, Type 304 ELC stainless was selected for this 90′ stripper column. Shop-fabricated by Graver in two sections and field-welded into one unit, the column was random-radiographed and tested to pressures of 162 psi. and 246 psi. Graver's expertness in fabricating and welding stainless is always assurance of trouble-free service.

to turn the battle against corrosion!

GRAVER®
ALLOY DIVISION

Building for the Future on a Century of Craftsmanship in Steels and Alloys

GRAVER TANK & MFG. CO., INC.
EAST CHICAGO, INDIANA
New York • Philadelphia • Edge Moor, Delaware • Pittsburgh
Detroit • Chicago • Tulsa • Sand Springs, Oklahoma • Houston
New Orleans • Los Angeles • Fontana, California • San Francisco

LETOURNEAU TRANSPORTERS...
ROLL RIGHT THROUGH
where even sunshine seldom enters

Jungle country: dark shadows at noon, vegetation hanging, dripping, forbidding entry . . . A bulldozed path punched through the morass — and above the raucous protests of native creatures, a steady thunder of diesel power . . . *The LeTourneau Transporter is rolling through.*

It may carry a drilling rig moving to location . . . heavy equipment to open up a mine or build a highway . . . or perhaps cement and steel for construction. When it rolls out again it may bring timber . . . oil . . . latex — anything that fits the pattern of commerce.

Even the jungle fastness yields to enough power, properly applied.

LeTourneau Transporters have that power: diesel - electric, like a locomotive. They apply it through wide, cushiony rubber tires with a powerful motor driving *every wheel* from inside its rim. If one slips, others take over its load until it regains footing.

Steel, rubber, and power—a massive rolling force that *penetrates* beyond the reach of road and rail — that's the LeTourneau Transporter, the pioneer vehicle for the last frontiers.

If you have an off-road transportation problem that's almost too tough to whip, send us your requirements and describe the country you must operate in. We'll make an analysis, and if a Transporter can profitably be used, a model to suit your needs will be recommended. There's no obligation, of course.

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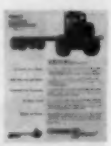
LETOURNEAU EQUIPMENT

Write for Free Literature ▶



R.G. LETOURNEAU INC TRANSPORTATION EQUIPMENT DIVISION

28611 South MacArthur • Longview, Texas • Cable Address: BOBLETORNO

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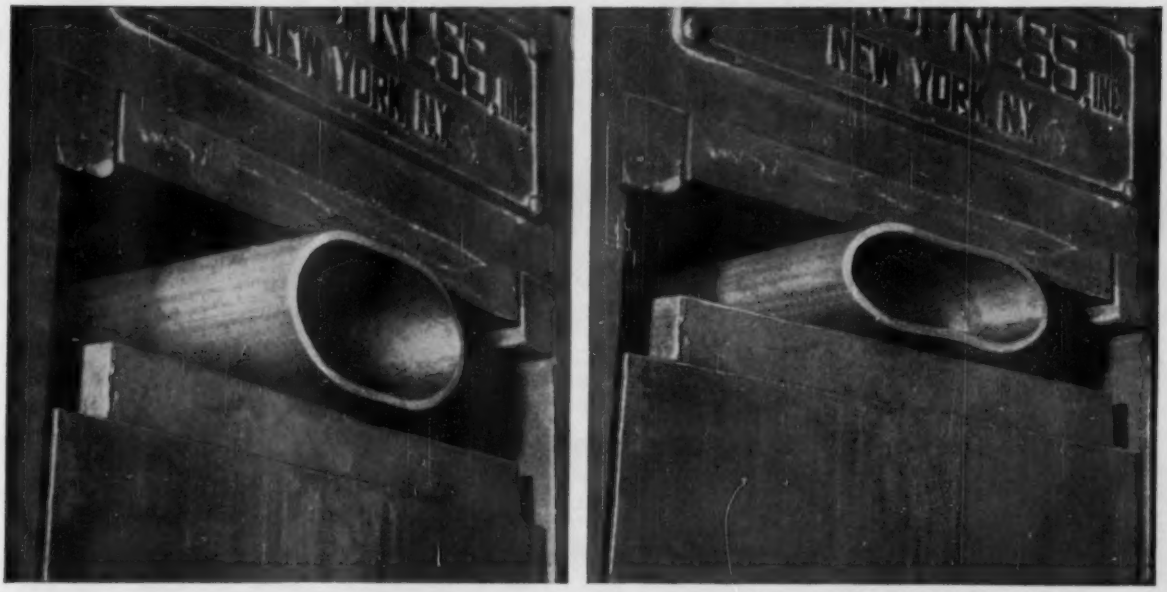
DUCTILITY



MAKES THE DIFFERENCE

when Kaiser Pipe meets the press!

ONLY the soundest welds, joining an extremely ductile steel, could stand the strain of the pipe-flattening test shown here.

We know, of course, that no electric weld pipe would ever be subjected to such rigorous conditions in the field.

Still, at Kaiser Steel we want to be *sure*.

So—52 times along the way from iron ore to finished pipe—we run exhaustive tests to keep the quality high.

We measure our pipe's strength and ductility. We inspect it thoroughly for roundness... concentricity... accuracy of dimension.

Thus, when you specify electric weld pipe from Kaiser Steel, you can be *certain*. Certain of performance to match your most exacting demands. Certain, too, of service when and where you need it.

Kaiser Steel

built to serve the growing West

Steel Mill Products: plates • hot rolled strip and sheet • cold rolled strip and sheet • tin plate • continuous weld pipe • electric weld pipe • alloy and carbon bars • bar shapes • structural shapes semi-finished steels • pig iron • ingot molds • coke by-products • **Fabricating Division:** steel fabrication for construction, aircraft, missile and other industries • expanded fusion weld pipe reinforced concrete pipe • tanks • For specifications, write: **KAISER STEEL CORPORATION** • **Los Angeles** • **Oakland** • **Seattle** • **Portland** • **Phoenix** • **Denver** • **Tulsa** • **New York**

WORLD'S MOST MODERN REFINERY — Tidewater Oil Company's new Delaware Refinery, 15 miles south of Wilmington, represents the most advanced thinking of refinery engineers and technologists.

LOW-COST WATER AND SOLIDS REMOVAL—A BASIC FOR MANY REFINING AND PETROCHEMICAL PROCESSES

Separator/Filters have multiple uses

Applications — In today's modern refineries and petrochemical plants, many processes are highly dependent upon low-cost removal of water and solid contaminants. Fram-Warner Lewis water separator/filters are extensively employed in process applications because their use provides the benefits of improved feed preparation, reduction in catalyst consumption, lower corrosion rates, and water free products.

Products Handled — LPG, gasoline, naphtha, distillate, gas oil, aromatics.

Special Uses—Feed stocks, treated and water-washed products, finished products to storage.

Description — Fram-Warner Lewis separator/filters offer a flexibility of design to meet a variety of process applications — Vertical single stage, horizontal single stage, horizontal two stage separator/filters with entrained water removal efficiencies of 90 to 100% and filtration efficiency down to 5 microns particle size. Engineering design and pressure vessel fabrication facilities at Warner Lewis Tulsa plant are always available to handle special problems to customer specifications. Let proven experience in the field in countless process applications help you.

For Further Information — Write Process Section Warner Lewis Company, Division of Fram Corporation, Box 3096, Tulsa, Oklahoma, for Process Manual on water separators/filters. Warner Lewis representatives are located throughout the United States and Canada and they will be glad to contact plant processing and operating personnel.

Double-Barreled SAVINGS . . .

when you use

MARTIN PLUNGERS

1 SAVE ON PLUNGER COSTS

One Martin Plunger will make many long runs, with only the rings being replaced. A set of rings costs only one fourth as much as a new plunger. Thus it is easy to figure the savings on the plunger alone.

2 SAVE ON BARREL COSTS

Metal to metal wear is eliminated. The resilient rubber & duck rings are so much easier on the barrel surface that barrels usually last several times longer. Here too is an important item in pump costs.

MORE BARRELS IN THE TANK TOO because of better seal, freer travel in the barrel and longer runs. AVAILABLE for your pump and your well, regardless of diameter, or depth or well condition. Get catalog No. 4 and read how to make selection and installation.

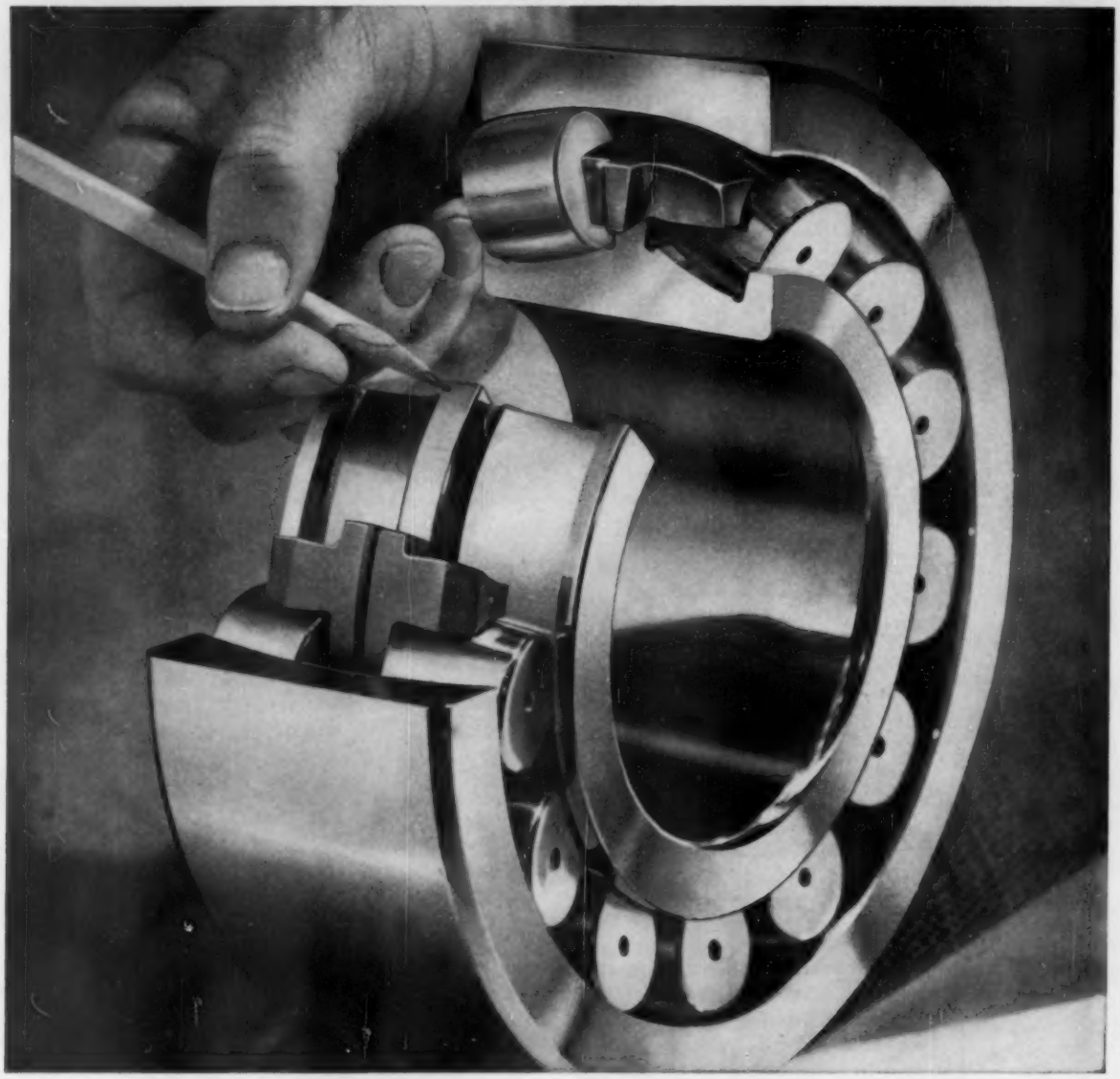
MARTIN PLUNGERS ARE SOLD THRU SUPPLY COMPANIES

JOHN N. MARTIN

Manufacturer

9 W. BRADY • TULSA, OKLA.

TORRINGTON *SPHERICAL ROLLER* BEARINGS



"This flange guides the rollers to peak performance!"

The center flange on the inner raceway of the TORRINGTON Spherical Roller Bearing positions the rollers to handle thrust loads. This accurate positioning also assures radial stability of the rollers under heavy loads—even at continuous high speeds and under conditions of misalignment.

This superior design feature is only one of many advantages you get when you specify TORRINGTON. For example, you get the service of TORRINGTON'S experienced engineers, who will help you with design and maintenance problems—or design custom bearings for special applications.

For long, low-maintenance service in heavy-duty applications, order TORRINGTON Spherical Roller Bearings. They're available from stock with either straight or tapered bore, for shaft or adapter mounting.

THE TORRINGTON COMPANY
South Bend 21, Ind. • Torrington, Conn.
District offices and distributors in principal cities of United States and Canada

TORRINGTON BEARINGS

Spherical Roller • Tapered Roller • Cylindrical Roller Needle • Ball • Needle Rollers

Weeds are a hazard you can't afford!

Destroy them with Baron, Radapon and other Dow products

The weeds around this tank farm aren't costing one single penny—*as long as they're not burning.* But a spark and a gust of wind could transform this tank farm into a tragic inferno!

Fire is the biggest threat posed by weeds, but it's not the only one. Weeds also hide poisonous plants and objects to trip over. They obscure vision around security fences, present an untidy appearance and generally cause a nuisance around tanks, pipelines, wells and plants.

Get rid of vegetation hazards with Baron®, Radapon® and other Dow products. Your own men can do this job, or professional contractors will assume full responsibility. Let us send you more information and the name of a qualified distributor near you.

Write for free new booklets on industrial vegetation control. THE DOW CHEMICAL COMPANY, Agricultural Sales Dept., Midland, Michigan.

YOU CAN DEPEND ON DOW

Advanced Forward Control Design does it again! This time it puts a big 9-foot pickup box on a 103½-inch wheelbase. With the engine behind the driver, more cargo space is available for bulky payloads of up to 3500-pounds!

New Forward Control 'Jeep' FC-170 Truck —engineered for your "impossible" jobs!

The Universal 'Jeep'. Whether transporting equipment for geologists or seismograph crews cross-country, or operating mobile drills for shot holes, the versatile Universal 'Jeep' is always on the move. It has the all-wheel traction and rugged stamina to help keep work moving smoothly on schedule.

Only the new and bigger 7,000-pound GVW Forward Control 'Jeep' FC-170 Truck spreads its cost over so many jobs in every phase of oil and gas operations. Advanced features plus 4-wheel-drive save time and money, help you get a bigger day's work done 365-days a year!

This completely new, more powerful 'Jeep' FC-170 Truck is the only 4-wheel drive truck with so much cargo space per inch of wheelbase. It has unequalled "big-load" maneuverability—takes crews, tools and equipment where ordinary trucks can't go—along the pipeline or on the lease. Its 8-inch ground clearance helps prevent "hang-up" in rough terrain. The bed is only 27-inches from the ground for back-saving ease of loading!

The new 'Jeep' FC-170 is powered by the high-torque Hurricane 6-226 engine, performance-proved the world over. Its spacious Safety-View cab puts you in a Forward Control position for greater command of any driving situation, on or off the road. With power take-off, the FC-170 operates a wide range of special equipment. See your 'Jeep' dealer for a demonstration today!

Other 4-Wheel-Drive 'Jeep' vehicles to do your jobs!

Forward Control 'Jeep' FC-150

The 'Jeep' Utility Wagon

Jeep / *Forward Control* / *4-Wheel-Drive* **FC-170**

WILLYS... world's largest manufacturers of 4-Wheel-Drive vehicles

WILLYS MOTORS, INC., TOLEDO 1, OHIO

POWELL—the most complete line of Alloy Valves* for Corrosive Services

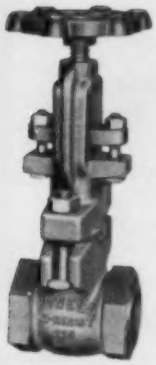


Fig. 2194—Small Ni-Resist. O.S. & Y. Gate Valve for 225 W.O.G. Larger sizes, flanged end, and swing check valves in Ni-Resist also available.

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at
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December 2 to 6
COLISEUM - NEW YORK

It's a fact . . . Powell offers more kinds or types of valves, available in the largest variety of corrosion-resistant metals and alloys, to handle practically every known corrosive fluid. The complete line includes gates, globes, angles, checks, "Y's", relief, flush bottom tank valves and others—for pressures from 150 to 1500 WP. A few are shown on this page.

Your local valve distributor will be glad to tell you all about them. If none is near you, write to us for the full facts on Powell Valves and Powell Engineering Service.

THE WM. POWELL COMPANY
Dependable Valves Since 1846
CINCINNATI 22, OHIO

**Powell Alloy (Corrosion Resistant) Valves are available with screwed or flanged ends. Flanged end valves conform to latest standards.*

Fig. 1832—Stainless Steel Gate Valve for 200 W.P. Screwed-in bonnet, inside screw rising stem, solid wedge disc.

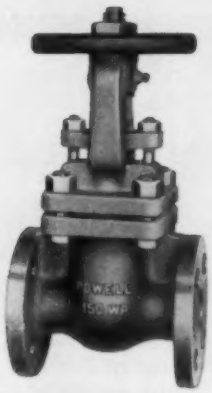


Fig. 2491—Stainless Steel Gate Valve for 150 W.P. Outside screw rising stem and yoke, solid wedge disc. Can be supplied with interchangeable split wedge disc

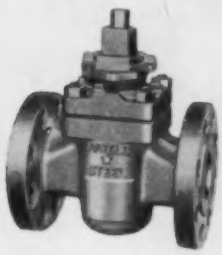
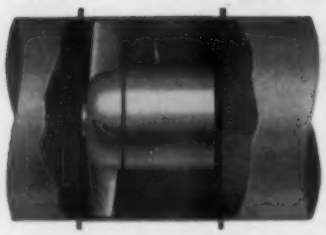


Fig. 1559—Steel Lubricated Plug Valve for 200 W.O.G. Screwed gland type. 6" and larger valves can be furnished for gear operation.

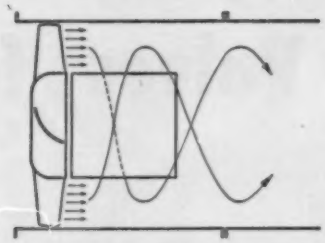
Fig. 1893—Large O.S. & Y. Gate Valve for Paper Mill Service. 3½ Nickel Iron Body, bonnet, yoke; stainless steel stem, screwed-in seat rings; Ni-Resist wedge.

Fig. 2433SS—Large size Stainless Steel Swing Check Valve for 150 W.P. Bolted Cap.

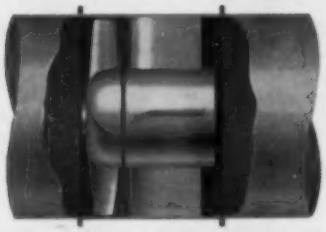
Fig. 2107—Stainless Steel "Y" Valve for 150 W.P. Plug type disc. Face to face and end flange dimensions conform to latest standards.



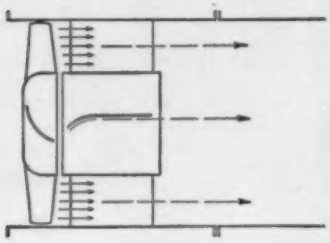
The tubeaxial fan . . . a wide range of volumes at medium pressures, with uniform velocity . . .



. . . at moderate pressures the spiral air discharge straightens out a short distance from fan blades.



The vaneaxial fan . . . stationary guide vanes reduce turbulence and increase fan efficiency . . .



. . . resulting straight-line air flow leaving fan assures smooth, quiet operation for all conditions.

Easy-to-install American Blower axial fans save space, lower your installation cost

Versatile American Blower axial fans can be mounted vertically or horizontally. When ducts are properly reinforced, the fan can be supported directly by the duct connection.

American Blower axial fans provide straight-line air flow, eliminating elbows, bends, and transformation pieces—can be installed vertically or horizontally in ducts, with minimum foundations and supports . . . with savings in space, first cost, handling, and installation.

These compact, self-contained axial fans are available in three general designs—vaneaxial for direct and V-belt drive, spray-booth vaneaxial for V-belt drive, tubeaxial for direct drive. A complete line of accessories is offered to adapt this versatile line of fans to your particular requirements. Capacities range from 2,500 cfm to 75,000 cfm. Larger sizes are available on special order.

For more information on axial fans, or on other equipment from American Blower's complete air-handling and -conditioning line, call our nearest branch office, or write direct to American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

AMERICAN BLOWER

Division of AMERICAN-Standard

Entire gas distribution system site-wrapped with Polyken tape

A simple, inexpensive, mobile assembly of cleaner, conveyor and wrapper—coats over 10,000 feet of pipe per day with Polyken Tape and overwrap.

Arkansas Louisiana Gas Company chose this method because it's fast . . . it's simple . . . it's sure

While *Polyken* tape is making big-inch pipeline news, gas companies are also finding it ideal for yard or site-wrapping small-diameter pipe in local distribution systems.

Such was the case here, when the Arkansas Louisiana Gas Company used The *Polyken* Method for an entire system including the two cities of Gould and Grady, Arkansas. The installation was made by the Worth James Construction Company, who has used *Polyken* tape on various jobs over the last five years.

In the words of Mr. James, the outstanding feature of this method is that "it eliminates the need for a hot coat plant for small projects."

Tough, durable *Polyken* is applied, as you see, right off the roll—without heat, liquids, solvents or thinners. That saves time, labor and equipment costs. Later, because of the extreme versatility of the tape, welded joints can be simply hand-wrapped.

Want to figure application costs on your job? Write, wire or phone: The Kendall Company, *Polyken* Sales Division, Dept. OG-K. 309 W. Jackson Blvd., Chicago 6, Ill. (WEbster 9-7100).

Complete catalog, Sweet's Industrial Construction File, Sec. 31/Ke

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THE PURE OIL COMPANY

Marketing Offices in Principal Cities of the Eastern, Central and Southern States
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NOW—your choice of THREE derricks for use with the Bucyrus-Erie 48-L

For deep hole drilling and servicing performance at its versatile, moneymaking best, you NOW have a choice of *three* derricks for use with the field-proved Bucyrus-Erie 48-L spudder. Each is specifically designed to handle your different kinds of work:

1. The *Standard 61' Derrick* for normal top-to-bottom drilling to 6,000 feet and well servicing to 7,000 feet;
2. The *Special Heavy Duty 70'4" Tripod Derrick* for heavy tool and casing work (handles up to 300,000-lb. casing loads with 10-part hoist);
3. The *Special 85' Servicing Derrick* for deep well workovers (handles up to 60,000 pounds of tubing, easily racks 30-ft. doubles).

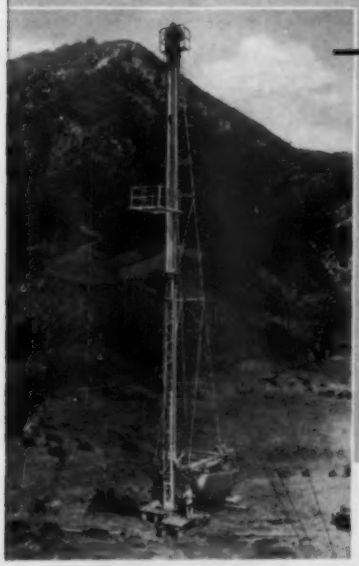
Look over the illustrations and specifications. Select the derrick best suited to your needs. Then, use the coupon to get the full story.

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

Standard— field-proved and unexcelled for strength and durability; telescopes to 38'3"; power-raised and power-lowered for quick, easy setups; swings up to 6,700-lb. tool strings; handles tackle pulls up to 160,000 pounds with auxiliary A-frame.

Tripod — the choice where a heavier derrick of greater height is required; power-raised and power-lowered; five-unit assembly is easily erected, quickly torn down for moves . . . each unit transported separately for convenience.



Servicing — a compact traveling unit with the necessary extra height, big capacity and strong structural design; telescopes and is power-lowered to lay down over the spudder for fast road travel; power-raised for easy field erection. Fingerboard arrangement holds up to 7,920 feet of tubing in 60-ft. stands.

FIRST with the FINEST in Spudders

BUCYRUS-ERIE COMPANY

South Milwaukee, Wisconsin

Please send me further information on the following derricks for use with the 48-L:

☐ Standard ☐ Tripod ☐ Servicing

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43557

Maybe you're paying

for top quality "Commercial Grade" Roller Bearings...BUT ARE YOU GETTING THEM?

Cutaway view of Rollway Tru-Rol® segmented-retainer roller bearing ... one of three distinct types of Tru-Rol bearings available.

True, there's a wide difference in quality and cost between the low-range and high-range of any "commercial grade" bearing. But every Rollway Tru-Rol "commercial grade" bearing approximates as closely as possible maximum standards of construction consistent with the price.

Take the matter of separators, for example: In Rollway bearings, separators give maximum guidance to each roller. The result is greater total load capacity and longer life.

Equal spacing of rollers means uniform distribution of load. The result is the elimination of destructive "pulse" and vibration.

Moreover, separators are of deep section, formed to the curve of the rollers, giving true axial alignment, smooth-surface contact and an even lubrication film on each roller

It's little things like these that mount up to big savings in service. Check the accompanying list, or ask a nearby Rollway Service Engineer to explain in detail the quality you should be getting in your "commercial grade" bearings. No cost. No obligation Just write us. Rollway Bearing Co., Inc., 586 Seymour St., Syracuse, N. Y., *manufacturers of a complete line of radial and thrust cylindrical roller bearings.*

ENGINEERING OFFICES: SYRACUSE • BOSTON • CHICAGO • DETROIT • TORONTO • PITTSBURGH • CLEVELAND • MILWAUKEE • SEATTLE • HOUSTON • PHILADELPHIA • LOS ANGELES • SAN FRANCISCO

Check This List AND BE SURE!

Retainer Operation

☐ Is the retainer roller-supported, to reduce sliding friction?

Retainer Construction

☐ Is the retainer strong enough to withstand shock loads and sudden reversals?

(A Rollway segmented-type steel retainer, such as that illustrated, is the strongest, most durable available in commercial grade bearings.)

Roller Spacing

☐ Are all rollers equally separated, or do some rub against each other in opposed-motion friction?

☐ Are rollers distributed evenly to prevent "pulse" and vibration?

Roller Construction

☐ Are the rollers crowned for optimum load distribution?

For Top Quality in Every Detail Buy Tru-Rol and Be Sure!

ROLLWAY
Tru-Rol
ROLLER BEARINGS

Applying NO-OX-ID Coating and Wrapper by Traveliner.

Mill- or yard-wrapping for long-term protection at its best.

Hand application of NO-OX-ID Cold Coating.

NO-OX-ID "C-M" Casing Filler protects casing and carrier pipe under highways and railroads.

NO-OX-ID coating-wrapper combinations are the versatile answer to every kind of pipeline protection

Whether you are installing distribution or transmission lines—whether you are working over rough or smooth terrain, there is a NO-OX-ID Coating and Wrapper Combination to give the right protection.

On mill-wrapped pipe, NO-OX-ID Coating, Wrapper and Service Coat protect from mill to ditch. NO-OX-ID can be applied over the ditch by Traveliner using less material and equipment. Hand-applied on short line installations, service lines or special fittings, NO-OX-ID goes on fast. No noxious fumes.

Leading pipeline contractors and utilities rely on versatile NO-OX-ID Coating and Wrapper Combinations. Consult with your Dearborn Pipeline Engineer. He will help you select the right combination for your next pipeline job.

New NO-OX-ID catalog

Just off the press. This 12-page illustrated catalog tells how NO-OX-ID combinations fit job requirements. Your copy is ready...USE THE COUPON.

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. OG-NO
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☐ Send my copy of the new NO-OX-ID catalog.
☐ Have a Dearborn Pipeline Engineer bring my copy.

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Dearborn NO-OX-ID®

Protecting Metal Against Corrosion for 70 Years

MARSH
Christmas Tree
GAUGE
...it stands alone-
In this latest development we reaffirm our pledge to make a better gauge ever better. Only in the Marsh Christmas Tree Gauge you have:
—A better tube construction— bourdon tube and socket fused into a one piece permanently leak-proof unit by the exclusive Marsh "Conoweld" process.
—A better movement—all but frictionless as a result of the self-lubricating effect of unlike metals. Coined sector gear gives greater strength where greater strength is needed; also smoother operation.
—A better case—a copper-clad wrought steel case of boiler plate thickness, produced by the "Marsh-alloy" process. It has the strength of steel, the corrosion resistance of copper, and is one-third lighter than conventional cast-iron cases. The case is finished in corrosion-resistant satin black enamel.
—the Marsh "Recalibrator"—not only the handiest way to keep a gauge accurate; also the best way.
★ There is a Marsh Gauge for every oil country and refinery application. Ask your supply house or write for latest bulletins.
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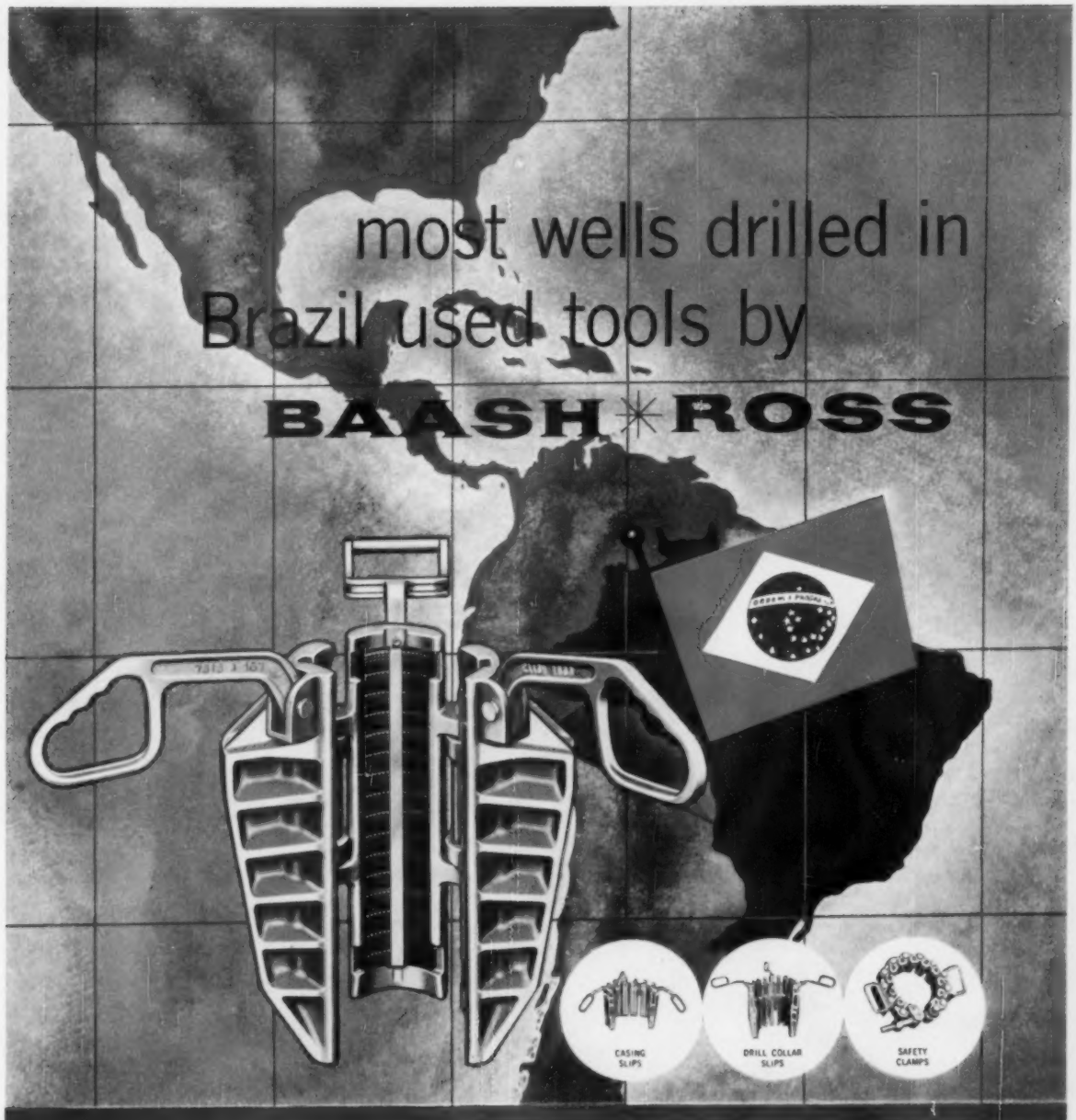

Baash-Ross

"DU" ROTARY SLIPS

are outstanding because...

FLEXIBLE-HINGED unitized design insures a uniform, full-circumferential grip on every setting.

SEGMENTED LINERS are easy to replace and are used on both "Regular" and "Long" bodies—give a safe grip that will not damage pipe.

THREE BODY SIZES fit wide range of pipe sizes—2⅜" to 7"—by simply changing liners.

AVAILABLE for all types and sizes of rotary tables.

For further information write P.O. Box 1343, Houston 1, Texas or see The Composite Catalog.

BAASH-ROSS TYPE "DU" ROTARY SLIPS are the most advanced slips available. Their wide range of adaptability is unsurpassed. Because of their unusually light weight and balanced design, crew fatigue is greatly minimized. The unique segmented liners reduce both maintenance and inventory cost—an ideal combination. Stocked at *your* supply store.

BAASH ✳ ROSS
TOOL COMPANY
DIVISION OF JOY MANUFACTURING COMPANY

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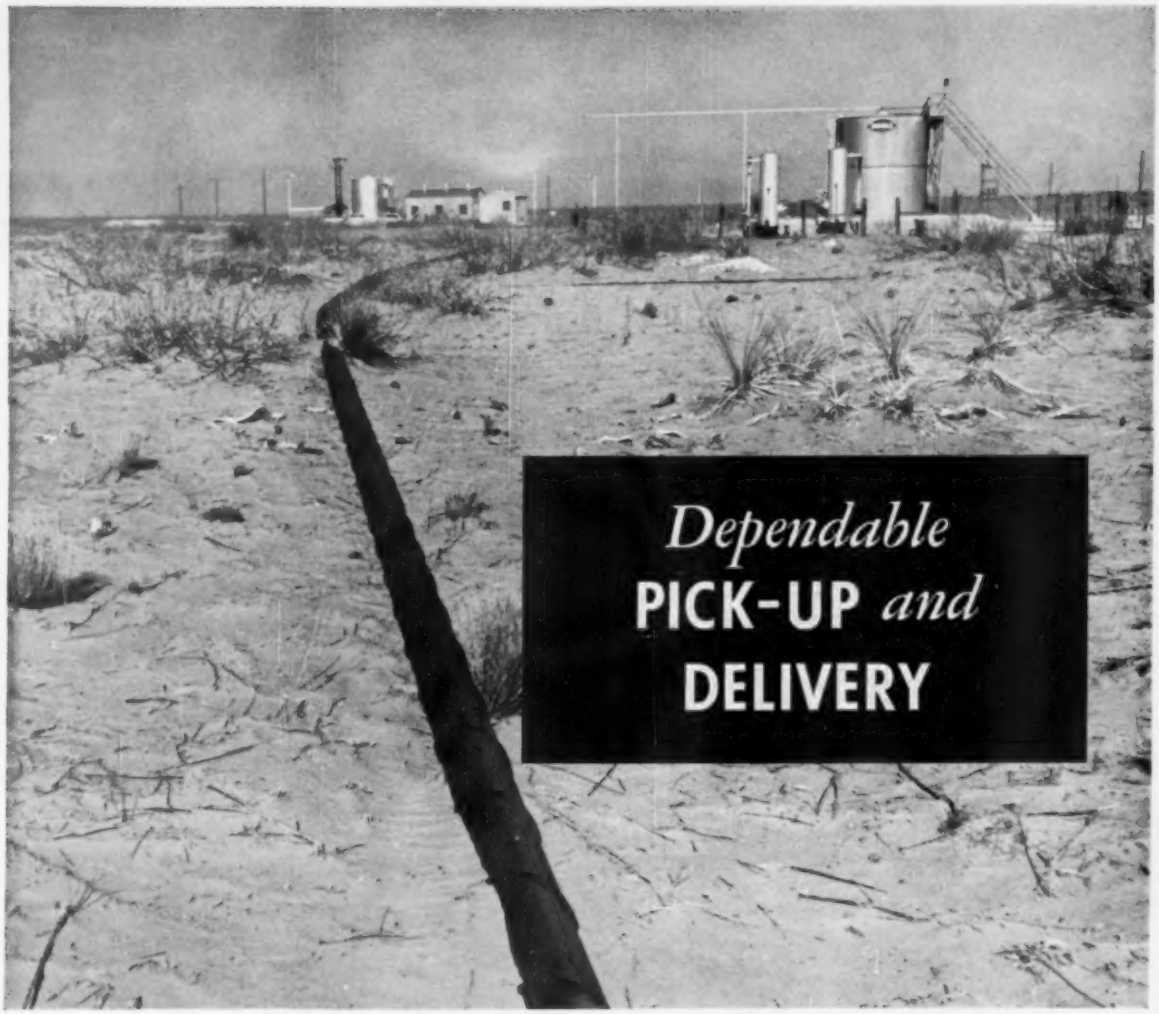

EXTRA performance and light weight make Naylor pipe outstanding in gas-gathering service. The spiral lockseam structure combines extra strength and safety in a light wall pipe that is easy to handle and install. It's dependable—built to absorb shock loads, stresses and strains, and to give you extra collapse strength. Naylor pipe is available with standard weight pipe ends for stronger field welds. Write for Bulletin No. 507 or call our distributors.

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NAYLOR PIPE COMPANY
1232 East 92nd Street
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EXCLUSIVE DISTRIBUTORS IN
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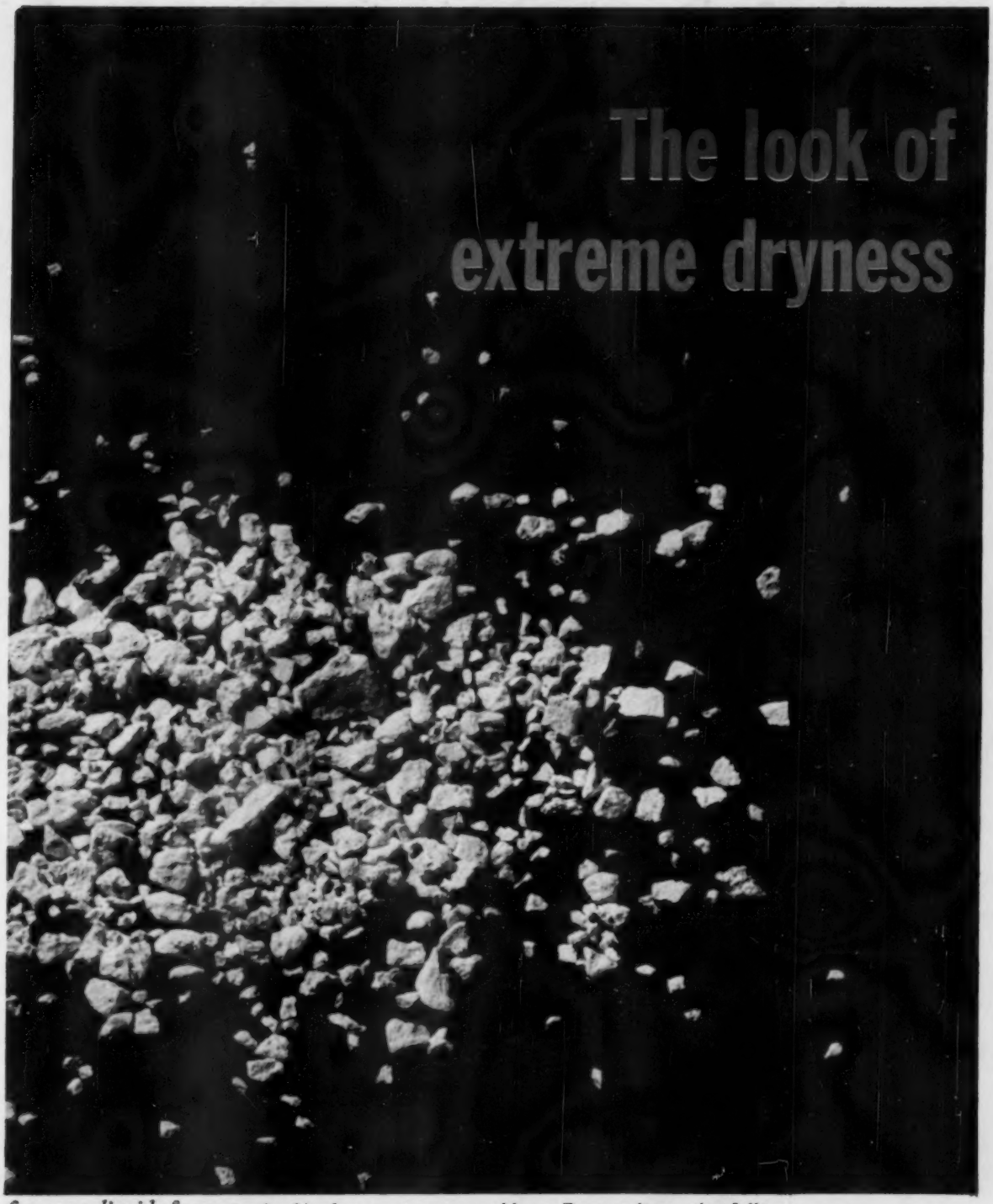


for gases, liquids & vapors—Looking for an efficient, *economical* adsorbent to obtain extreme dryness in gases, liquids or vapors? Then look to ALCOA® Activated Alumina, the oldest, most thoroughly proved commercial adsorbent available.

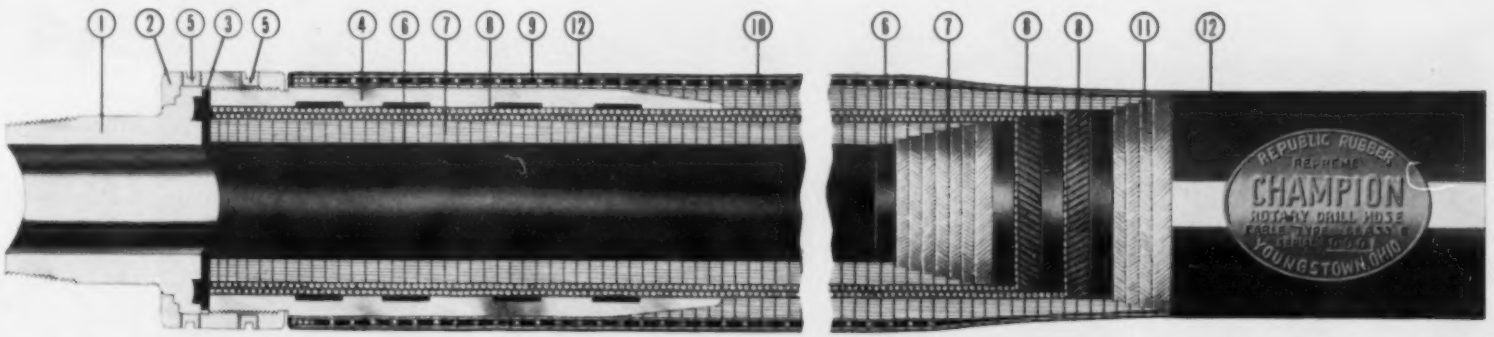
ALCOA Activated Alumina dries to lower dew points (minus 100°F and lower) than any other commercial desiccant. Nontoxic, noncorrosive and chemically inert, it relieves you of contamination worries and eliminates many serious maintenance problems. Because it remains fully effective through almost unlimited saturation-reactivation cycles, it insures lowest possible dehydration costs.

Let ALCOA help you solve your dehydration problems. Get complete information today on the properties and performance of ALCOA Activated Alumina. Write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 715-L Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA CHEMICALS

NEW! "ALCOA THEATRE" Exciting Adventure Alternate Monday Evenings

Here's the INSIDE STORY...



12 REASONS WHY REPUBLIC CABLE-TYPE ROTARY DRILLING HOSE IS SAFER AND LONGER LASTING

1. **Nipple Head** of tough alloy steel will give maximum service. Standard A.P.I. threads.
2. **Collar** firmly attached to couplings. Will stay put.
3. **Sealing Gasket** specially compounded. Seals pressure in.
4. **Republic Couplings** give you a hose with no weak spots. In ordinary rotary hose, reinforcing wires or cables are placed over the couplings. Spacing between wires must be widened since O.D. of hose and coupling combined is greater than hose itself. These gaps create a weak spot at a critical point. Republic's new coupling design keeps the wire cable snugly and evenly spaced against the hose all the way and underneath the couplings . . . giving uniform strength the entire length of the hose and still maintaining the important full-flow feature.

THERE IS NO WEAK POINT IN A REPUBLIC ROTARY HOSE.

5. **Set Screws** prevent loosening of collar and nipple head.
6. **Hot Oil & Abrasion-Resistant Reprene Tube** resists wear of corrosive drilling muds, withstands swelling and softening effect of oil.
7. **Multiple Fabric Plies** give greater resistance to pressure.
8. **Steel Cables** imbedded in rubber guarantee strength and reduce pulsation and vibration during pressure surges.
9. **Circumferentially-Wound Steel Cable** reinforces ends and prevents kinking at these critical spots.
10. **End Reinforcing Fabric Plies** work with the steel cables discussed in No. 9 to give even greater insurance against kinking and breaking at the vital hose ends.
11. **Additional Fabric Plies** give extra strength and permanently anchor reinforcing cables in place.
12. **Extra Tough Reprene Cover** will resist cutting, abrasion, and weathering. Oil resistant.

CLASS C

Each Length tested to 5,000 lbs.

THERE'S NO BETTER HOSE MADE!

REPUBLIC RUBBER DIVISION

LEE RUBBER & TIRE CORPORATION, YOUNGSTOWN 1, OHIO

INDUSTRIAL RUBBER PRODUCTS

The Race for the 46th . . .

OKLAHOMA'S 50TH ANNIVERSARY

Statehood wasn't the original stake in the land-minded "Run of '89."
Unknown to most, the "46th Star" of our country's flag was in the stirrups
that day, riding hard and fast to stake a claim that would be recognized 18 years later.

Born of the vigorous spirit of their "leather-slapping" forebears, National Bank of Tulsa stands "tall-in-the-saddle" among the nation's banking fraternity. Recognized leadership, in all phases of petroleum financing, distinguishes the highly specialized services of our Oil Department. It's available to you at the "Oil Bank of America."

NATIONAL BANK OF TULSA
THE OIL BANK OF AMERICA
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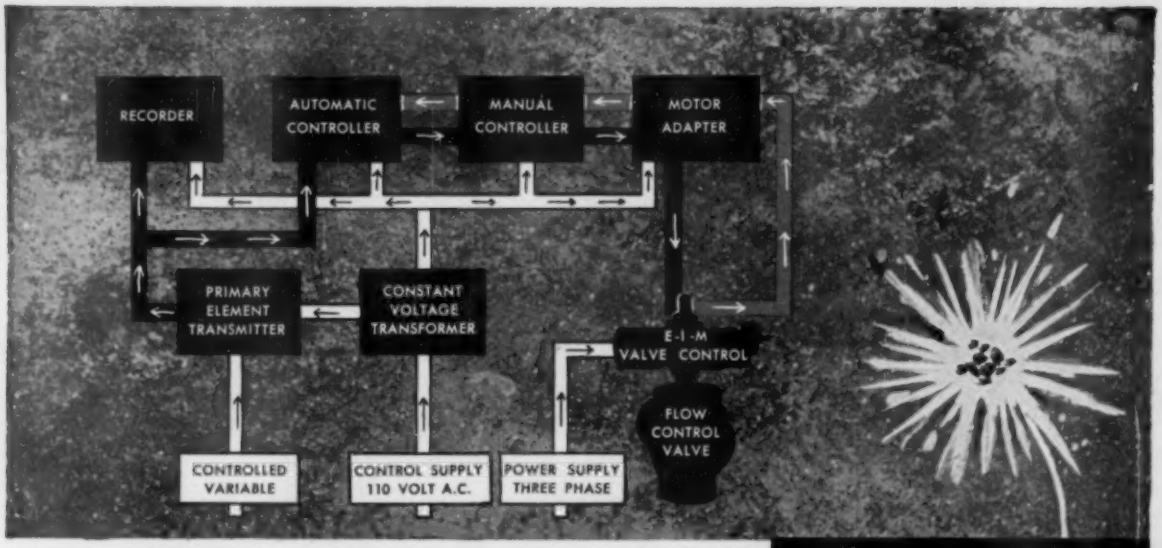


The valve control of the future TODAY

EIM
FUTRONIC
VALVE CONTROL

E-I-M FUTRONIC valve control, the first all electric power operator for actuating control valves in throttling and regulating services.

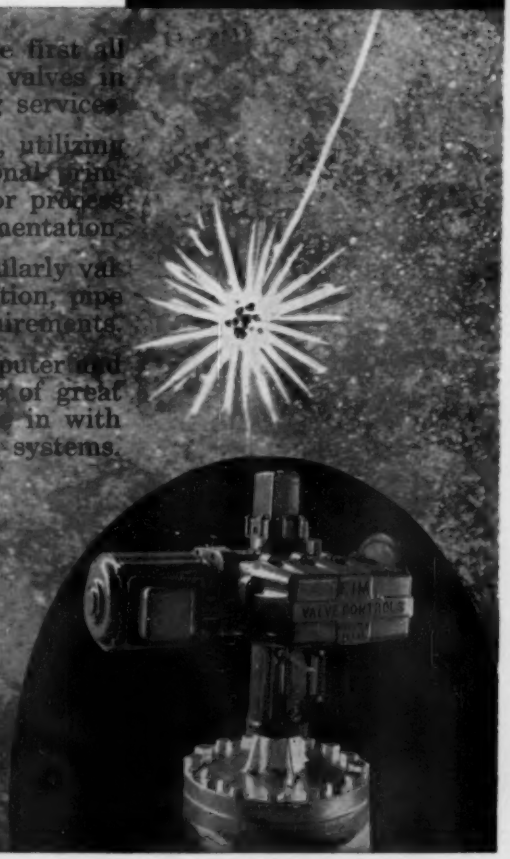
The fully flexible electronic control system, utilizing A.C., D.C., motion inputs as well as conventional primary elements, is highly suitable for process and power instrumentation.

The FUTRONIC valve control system is particularly valuable in meeting pipe line compressor station, pipe line pumping station and metering station requirements.

Units are adaptable for readout, cascading, computer and similar systems. Transmission distances of great length are permissible and it is possible to tie in with leased wire, micro-wave and other metering systems.

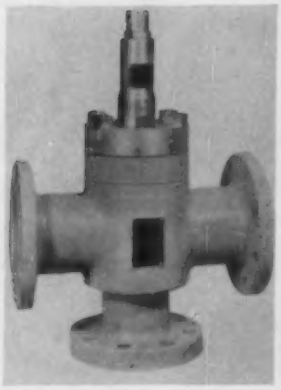
For complete details of the FUTRONIC valve control write

E-I-M
COMPANY, INCORPORATED
1640 Old Spanish Trail
Houston 25, Texas



SHOWCASE...

NEW EQUIPMENT



Relief Valve Uses Free-Floating Piston

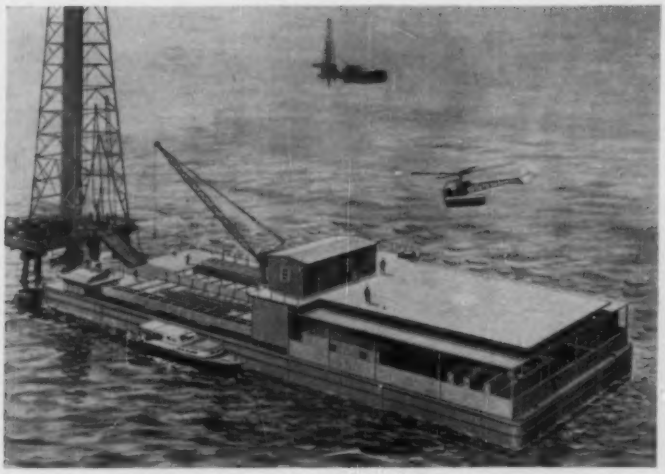
This new Agco Type 2 soft-seat pilot-operated relief valve is suited for gas or vapor service at pressures up to 1,500 psi. Full capacity is obtained with zero overpressure or accumulation, the maker says.

The basic operating part of the valve is the free-floating piston of differential area design. Pressure on the upper or larger surface of the piston is reduced by venturi action when the small spring-loaded pilot opens. This allows the piston to rise and the valve to relieve.

Teflon disks are used in both the main and the pilot valve. These assure a bubble-tight seal before relieving and after reseating, the maker claims. The Teflon is tough, resilient, and resistant to corrosion and mechanical damage.

The pilot-valve assembly is interchangeable for all valve sizes. The valve's orifice diameter equals the diameter of the pipe. Available valve sizes are: 2-in. inlet with a single 3-in. outlet, 3-in. inlet with dual 4-in. outlets, and 4-in. inlets with dual 6-in. outlets.

Line restrictions caused by block valves or other equipment adjacent to the inlet do not cause chattering or malfunctioning, the maker says. A manual blow-down valve can be obtained on all styles for check popping or for blowing down the line. **Write or call: Anderson, Greenwood & Co., 1400 North Rice Avenue, Bellaire, Tex., for details on Type 2 relief valve.**



New Tender Built for Lake Drilling

The new tender is a nonself-propelled type for use in conjunction with a drilling platform on Lake Maracaibo. Measuring 180 by 70 by 11 ft. 3 in., it's designed with many special features. These include elevation of the active mud tanks 4 ft. above the deck. This creates a semi-flooded suction and improves pump operation, the maker points out. A dual mud ditch is included. The reserve mud-pit capacity is 2,650 bbl. and the active mud-pit capacity is 800 bbl.

Living quarters include a bunk room, office, galley, and mess area. Completely air conditioned, they are on a second deck above the main deck, affording a good view of drilling operations.

On the second deck, a helicopter landing area is provided. Measuring

Send this **Showcase Coupon**

to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in bold-face type at end of description.

NAME AND/OR MODEL NUMBER.....

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Described in OIL AND GAS JOURNAL - Issue of November 18, 1957

NAME.....TITLE.....

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ADDRESS.....

CITY.....STATE.....

DATE.....

New Equipment

45 by 73 ft., it is equipped with landing lights and a target.

Located on the pipe deck, the crane has a capacity of 15 tons. Anticorrosion paint protects the exterior of the hull and mastic compound the interior. Magnesium-bar cathodic protection is provided on the exterior of the hull below the water line. A 5-ft. sea wall surrounds the machinery deck. Removable stanchions on the pipe rack contain the pipe in bins. The tender includes engines, generators, a mechanical-electric compound drive, mud pumps, and other equipment for use with an electric draw works.

Both the draw works and its electric-motor drive mount on unitized skids, permitting both to be easily transferred to the derrick platform. **Write or call: National Supply Co., Two Gateway Center, Pittsburgh, Pa., for details on lake type of drilling tender.**

Motor Valve Allows Fast Trim Replacing

The seat trim on this new Macco Type DC motor valve can be replaced and the well back in operation within minutes, according to the maker. A simple tap loosens the wing nut. The seat can then be replaced without a wrench or special tools.

All moving parts are protected from the elements. A built-in self-purging drip chamber is said to eliminate freezing normally caused from condensate formation.

All assembly connections and moving parts have self-contained lubrication. They are positively sealed with O-ring seals. Features of the valve include: (1) visible open-shut indicator, (2) a time range of 10 seconds to 24 hours, (3) built-in pilot-gas drip chamber, and (4) simple conversion to direct or reverse acting. The all-steel body is rated at 3,000 psi. **Write or call: Macco Oil Tool Co., P. O. Box 7288, Houston 8, Tex., for details on Type DC motor valves.**

●

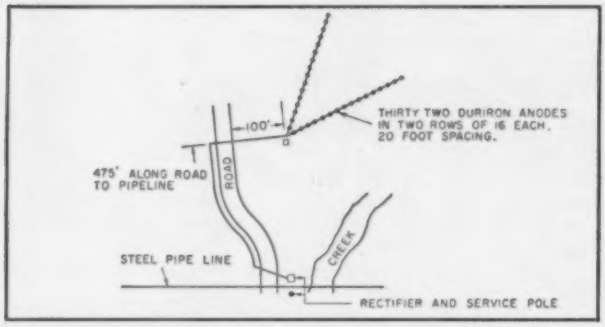
Mud Valve Is Easy To Take Apart

Field replacement of the wear rings and gate packer in this new Type R Flex-Seal mud valve is simple. The subs and bonnet cap remain rigidly in

32 DURIRON® ANODES

protect 11,000 feet of steel water line without backfill

The Problem: An isolated section of 11,000 feet of steel water line needed cathodic protection. Tests showed current requirements to be 40 amps., but replacement of adjacent wood stave lines called for extra capacity. Ground was a peat bog with water table standing at 6 inches below surface, making backfill methods impossible.


100'
THIRTY TWO DURIRON ANODES IN TWO ROWS OF 16 EACH, 20 FOOT SPACING.
475' ALONG ROAD TO PIPELINE
ROAD
CREEK
STEEL PIPE LINE
RECTIFIER AND SERVICE POLE

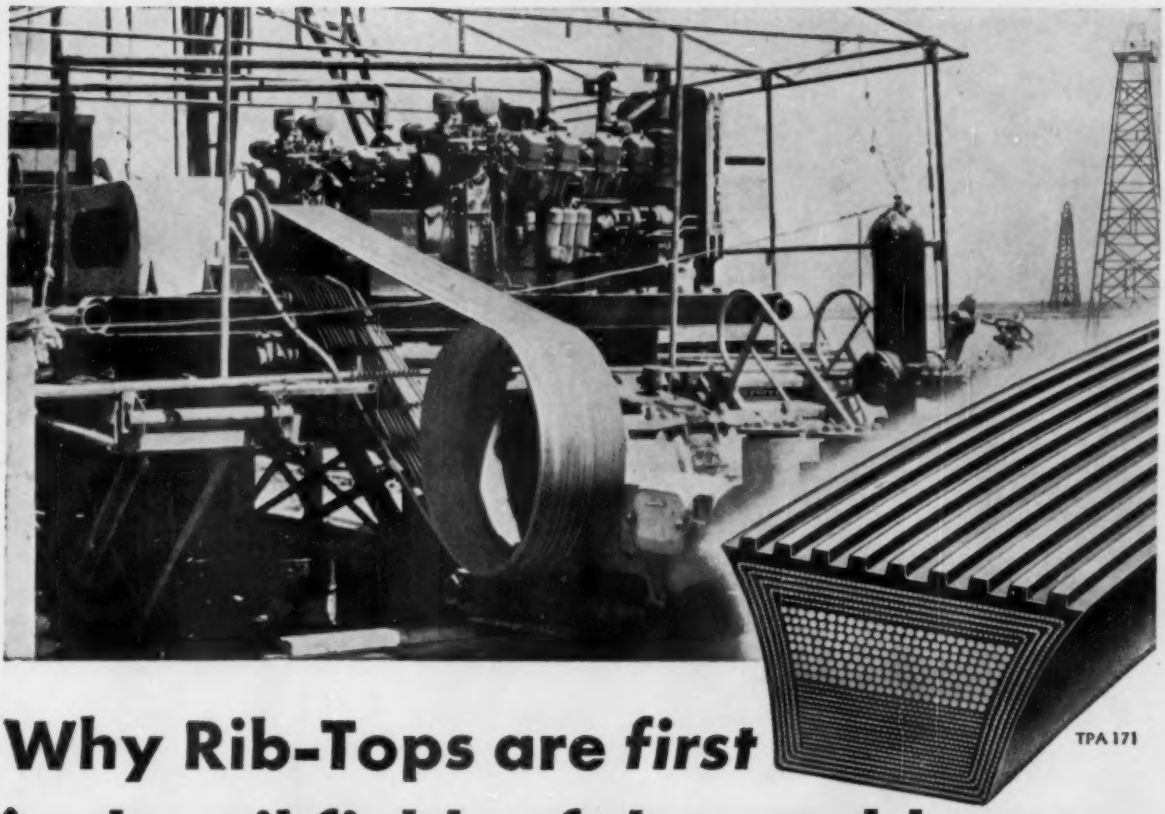
The Installation: 32 Duriron Anodes (2" x 60") were installed without backfill, by digging through the dry surface and then pushing anodes down until the tops were 3 feet below surface. Anodes were installed 20 feet apart, in two rows, with a calculated resistance of one ohm, based on previous experience with similar installations. While conventional backfill columns would have reduced the number of anodes necessary, the use of bare anodes constituted a major saving in cost.

The Performance: The anode bed is discharging 60 amps. at a terminal voltage of 59 volts. The entire line section is under protection, the minimum potential being 1.18 volts. This affords ample margin to handle prospective additions to the line. Agreement between actual and calculated anode resistance is quite close.

Action: For further information on this particular installation or for technical assistance on other Duriron impressed current anode installations, write:

DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

THE DURIRON COMPANY, INC.
DAYTON 1, OHIO



Why Rib-Tops are *first* in the oil fields of the world

The four engineering developments shown at the right have made Rib-Top first choice for mud pump operation with drillers around the world.

Yet Rib-Tops cost no more than ordinary belts of comparable ratings.

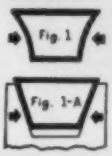
For fewer V-belt replacements and lower cost on mud pump drives, always specify Rib-Top. Both Standard and Super Rib-Top are available at your nearby oil field supply house.

Put Super Rib-Top on your toughest drives.

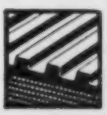
With 40% more horsepower capacity, Super Rib-Top easily handles drive overloads. Fewer belts and narrower sheaves solve space and weight problems.

No other V-Belt has ALL these advantages

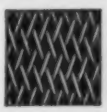
1. **Tougher, more resilient cords** are able to absorb the severe pulsations of mud pumps; easily handle peak loads.



2. **Concave Sidewalls** (U.S. Pat. 1813698) Concave sides (Fig. 1) increase belt life. As belt bends, concave sidewalls become straight, making uniform contact with sheave groove (Fig. 1-A). Uniform contact means less wear on sides of belt . . . far longer belt life.



3. **Stabilizing ribbed tops** (U. S. Pat. No. 2548135) are exclusive with Gates. They dampen vibration, protect top of belt from damage, keep belt running smoothly over idler-equipped mud pump drives with no side whip.



4. **Flex-Weave Cover** (U. S. Pat. 2519590) A Gates exclusive: provides greater flexibility with far less stress on fabric. Cover wears longer . . . increases belt life . . . more power available to driven machine.

Gates® *World's Largest Maker of V-Belts.*

The Gates Rubber Company
Denver, Colorado

Gates Rib-Top Vulco Rope

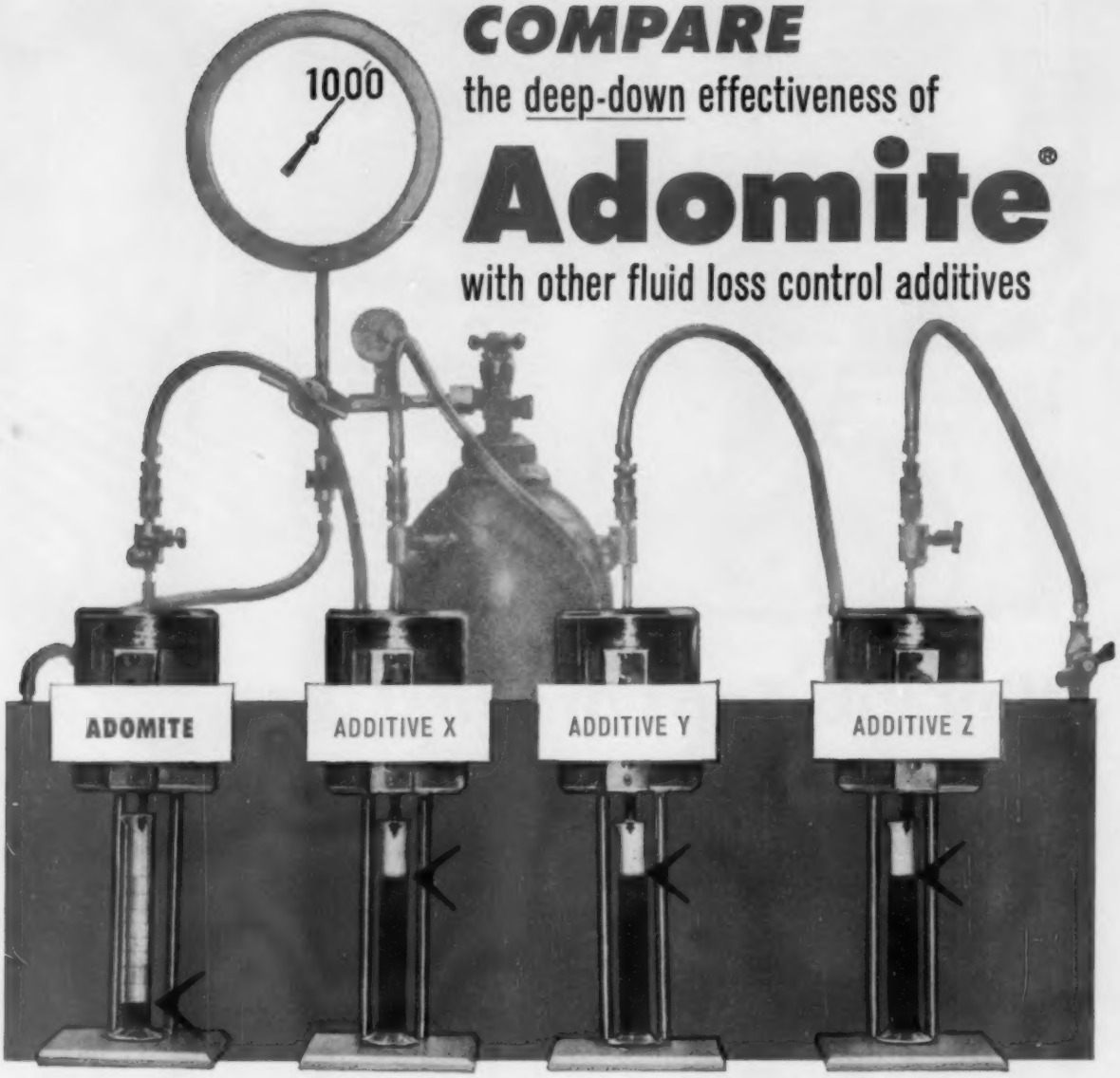
DEVELOPED ESPECIALLY FOR MUD PUMP DRIVES

COMPARE

the deep-down effectiveness of

Adomite®

with other fluid loss control additives



Just how effective is your present fluid loss control additive at bottom hole conditions? As you undoubtedly know, many fracturing additives show desired fluid loss control at surface conditions of low pressure and room temperature. But at bottom hole conditions, fluid loss becomes so high that their effectiveness is lost. Compare them with Adomite. Tests show that, *deep down*, nothing safeguards your profits like Adomite.

What makes the difference?

Adomite, when mixed with oil, disintegrates into millions of tiny particles. These particles seal the face of the formation and keep the fracturing fluid from filtering in. Temporarily sealing the formation, Adomite particles do not plug it.

Other additives, too, contain sealing particles, but these tend to soften or dissolve as temperatures increase. Result: fluid loss control is greatly reduced.

	Fluid Loss at Surface Conditions— 100 psi,* 75°F., cc/30 min.	Fluid Loss at Bottom Hole Conditions— 1000 psi, 150°F., cc/30 min.
ADOMITE + crude oil	2.2	22.0
Additive X + crude oil	37.8	Infinite
Additive Y + crude oil	8.5	Infinite
Additive Z + crude oil	13.0	295 (1 min., 50 sec.)

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(*Standard API Code 29 Test)

To get best results downhole with straight crude, gelled crude or refined oil, always *specify* Adomite.

FRACTURE WITH ADOMITE

New Equipment

place in the mud line while the bonnet is removed to expose parts for replacement.

For added rigidity, modified subs are tack welded to the bonnet cap. These welds are structural only. They are not subject to pressure. By removing them, worn subs may be replaced easily. But the modified subs thus welded do permit the wear rings and gate packer to be changed as a unit without moving the subs apart or taking the bonnet cap from the line. And they make misalignment impossible, the maker says.

The mud valve is available in sizes of 2 to 4 in. for working pressures from 960 to 5,000 psi. **Write or call: Cameron Iron Works, Inc., P. O. Box 1212, Houston, Tex., for details on Type R mud valve.**

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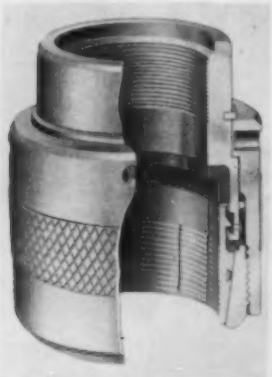


Coupler Quickly Connects Cement Heads

According to the maker, the quick coupler provides an entirely new method for coupling equipment to well casing. It is said to completely eliminate the older method of screwing cementing heads directly onto well casing with the resulting problems of centering and possible cross threading.

The quick coupler consists of a cylindrical-steel sleeve with internal slips. The slips are taken up by manual rotation of the outer body. Interior pressure tightens the coupler which contains internal packing to provide a fluid-tight seal.

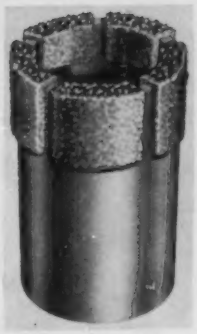
The top of the coupler has a female thread for attachment to the lower end of the cementing head and plug holder. The maker says the new coupler minimizes the time lost between landing the pipe and establishing circulation. And it eliminates the need to remove the cementing head from the casing in multiple-plug operations.

Applications for the coupler include field testing of casing; blow-out and fire control; and connection of tubing for hot-oil injection on remedial jobs. **Write or call: Chiksan Co., Brea, Calif., for details on quick coupler for cementing heads.**

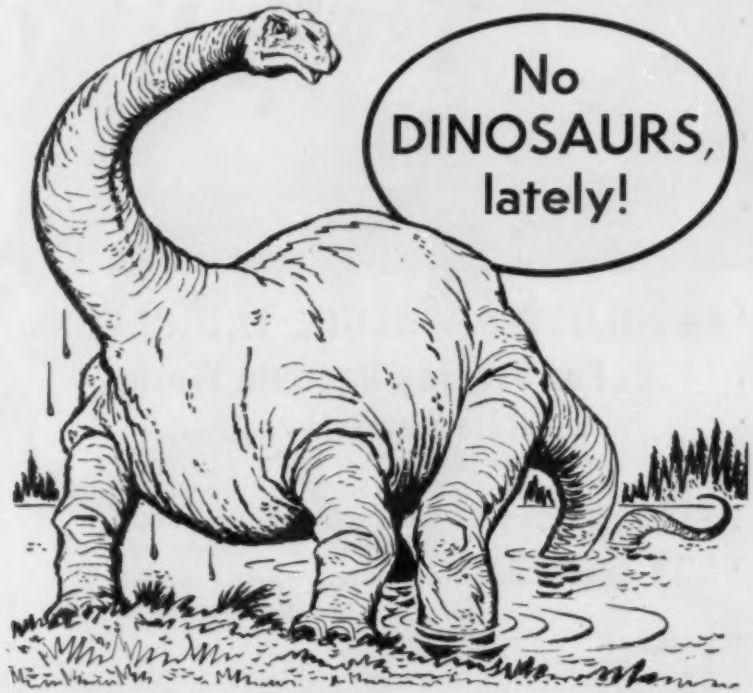
●

Washover Shoe Aids Well Cleanup

To withstand such punishment, this Type C washover shoe utilizes Itcoloy,



a tungsten-sintered carbide. This material allows it to reduce to circulable sizes many forms of junk for com-



The extensive magnesium silicate deposits laid down about the time dinosaurs roamed Florida's marshy peninsula became the source of today's most wisely used adsorbent.

Because it contains numerous small fibrous tentacles, Florida Fullers Earth, in its commercial form known as Florex, is particularly valuable in the adsorptive refining, decolorization, clarification and neutralization of mineral, vegetable, and animal oils, fats and waxes. Florex is unequalled in high quality or low cost for processes involving the use of highy active clay for sweetening light distillates, dehydration, desulfurization, and polymerization.

Standard meshes from 2/4 to 200/up and our experienced adsorption specialists are available to help you solve complex laboratory or production problems.

FLORIDIN COMPANY

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Desiccants
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ABSOLUTE PRESSURE INDICATOR
...For Precise Vacuum Work

Accuracy:	1/300 of full scale	
Sensitivity:	1/500 in *all* ranges	
Ranges:	0-50mm Hg.	0-100mm Hg.
	0-200mm Hg.	0-410mm Hg.
	0-800mm Hg.	390-800mm Hg.
Dial Sizes:	2¾" or 6" diameter for all ranges	

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PETROLEUM DISTRIBUTING COMPANY
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plete well cleanup, the maker says.

The shoe is designed to run on the bottom of a washover string to provide clearance between the fish and the sides of the hole, whether the obstruction or obstacle is on the fish or in the hole.

The tungsten-sintered carbide contains 65 per cent sintered crushed tungsten carbide with a guaranteed hardness of 91.08 to 93 Rockwell A.

A silver-bearing alloy, the matrix has a shear strength of 100,000 psi., and the work hardens to 260 Brinell. The matrix forms a relatively resilient base which prevents undue breakdown of the carbides under high impact conditions, according to the maker. **Write or call: Bowen-Itco, P. O. Box 4587, Houston 13, Tex., for details on Type C rotary washover shoe.**

●

Selenium Rectifier Features Long Life

The rectifier is a high-current-density industrial type. According to the maker, field experience indicates the new selenium cells have a life expectancy of 100,000 hours.

For the same current load, the cells are only half the size of conventional selenium stacks, yet they have a lower voltage drop, company officials say. The long life, negligible-aging characteristics and low voltage drop are attributed to a special vacuum technique and processing which eliminate the artificial-barrier layer characteristic of some selenium power cells. The result is said to be greatly reduced servicing problems in maintaining cathodic protection equipment. **Write or call: Radio Receptor Co., Inc., 240 Wythe Avenue, Brooklyn, N. Y., for details on pipeline selenium rectifier.**

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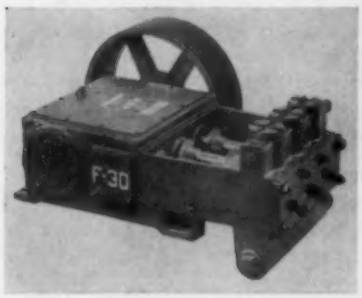


Triplex Pump Offers Nine Plunger Sizes

This new National Type F-30 triplex plunger pump providing nine plunger sizes offers four sizes between 1¾ and 2½ in. in the F-30-L pump

KAAR'S FIVE ROUGHNECK RADIOS FOR COMMUNICATION IN THE FIELD

✓ BASE ✓ VEHICLE
✓ FIELD CAMP
✓ FOOT PARTY

Only Kaar offers a complete system for field communications. The five sets represent the finest engineering in the medium frequency range. And they can take it in the worst climates of jungle, arctic, or off-shore.

At the base station, depending on your range of operations, there are two sets to choose from, the 100 watt six channel TR 242, and the 150 watt nine channel TR 222, with frequency ranges of 2-5 mc and 2-6 mc respectively.

For the vehicle, the rugged, shock mounted 50 watt single or dual channel TR 245. It's a lightweight, compact unit with a frequency range of 1.6 to 8 mc. With a low power drain of only 2.5 amps (stand-by on 12 V systems) the TR 245 won't sap your vehicle battery.

For the foot party, a pint-sized roughneck. It's a two watt 23 pound packset, the TR 246, with a frequency range of 2-8 mc.

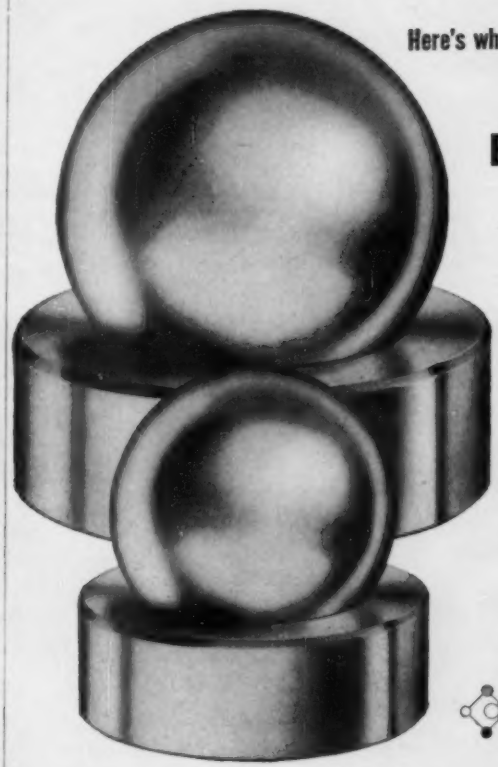
Wrap up your field communication needs in the Kaar package, the only complete system made. For additional information, write to us:

Illustrated is the 50 watt TR 247. Packed in a rugged fiberglas carrying case, it is ideal for field camp use. Included in the design are provisions for time break circuitry for geophysical exploration data transmission.

Kaar ENGINEERING CORP.
2925 MIDDLEFIELD ROAD
PALO ALTO, CALIFORNIA

Here's what you get with

KENNAMETAL* BALLS and SEATS



EXCEPTIONALLY HIGH RESISTANCE TO

- Fluid Cutting
- Wear • Corrosion
- Electrolytic Action
- Ball Pounding
- Ball-on-Seat Shock

If you have a problem well, or just want longer life, less pump downtime, ask your pump service man to install Kennametal API Balls and Seats. They will cost you less in the long run. KENNAMETAL INC., Latrobe, Penna.

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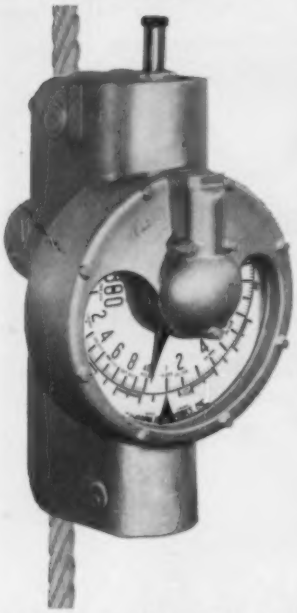
INDUSTRY AND KENNAMETAL ...Partners in Progress

STRAIGHT DOWN DRILLING



For faster, straighter hole, the tough Cameron Type "C" Weight Indicator has no equal. Temperatures in the field change abruptly from tour to tour but the Cameron Type "C" Mechanical Weight Indicator continues to register - accurately and dependably. The reason is simple - Cameron Weight Indicators have no hydraulic system to pick up or lose pressure with temperature changes. There is no possibility of breakdown due to leakage of high pressure fluids. The large yellow dial of the Type "C" with bold contrasting black and red numerals makes the indicator readily visible from any point on the rig floor. The indicator case is oil-filled (like the Cameron pressure gauge) to provide a viscous damping of dial motion to prevent damage from vibration.

Give one a try. Your bits will bite into any formation with exactly the right pressure for peak drilling efficiency. All bottom hole operations requiring precise weight control will be easier with the Cameron Type "C" Weight Indicator.

Cameron
IRON WORKS, Inc.
P. O. Box 1212 - Houston, Texas
Export Office: 7912 Empire State Bldg., New York City. In England: Cameron Iron Works, Ltd., Time & Life Bldg., New Bond Street, London W. 1 England

and five sizes between 1 and 1½ in. in the F-30-S pump.

The single-acting triplex pump is designed for multiple services in the oil field. It provides a wide range of performance. Capacities range from 6.1 to 86 g.p.m., depending on plunger size and speed of operation, speeds range from 200 to 450 g.p.m. Discharge pressures of 600 to 3,735 psi. are available at 13.3 to 30-hp. output.

Cylinders for either corrosive or noncorrosive fluids are available. **Write or call: National Supply Co., Two Gateway Center, Pittsburgh, Pa., for details on Type F-30 triplex plunger pump.**

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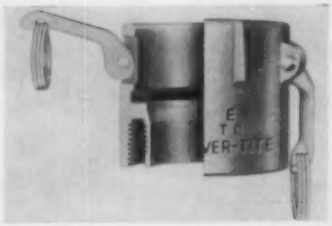
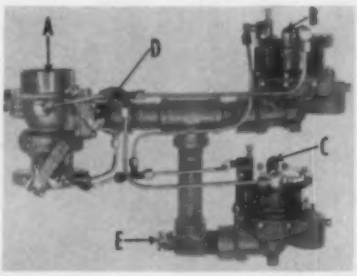


Quick-Coupler Speeds Product Transfer

This new M.I.D. quick coupler eliminates the necessity of attaching a conventional hose coupling and then the addition of a quick coupling, the maker says. The body portion is constructed of a single brass forging.

When the coupler is used in conjunction with an Ever-Tite tight-fill system, fast product delivery is achieved, according to the maker. **Write or call: Ever-Tite Coupling Co., Inc., 254 West Fifty-fourth Street, New York 19, N. Y., for details on M.I.D. quick coupler.**

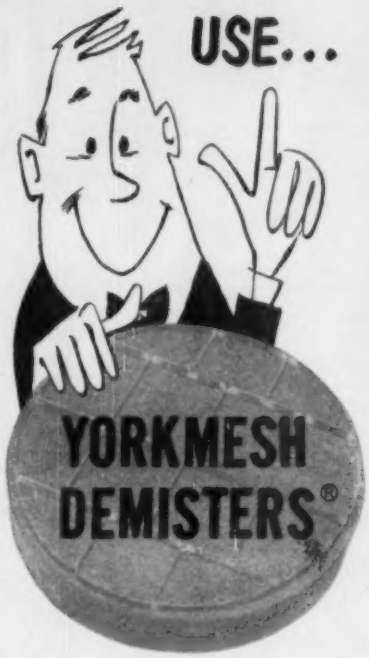
●



Fuel System Gives Automatic Change

Suited for gas engines in plants or on drilling rigs where the B.t.u. value of the fuel-gas varies, this automatic

You Should USE...



to get Clean Separation of vapor from liquid in your process equipment!

WHY?

To improve overhead product quality, or to eliminate liquid overhead losses, and permit increased throughput rates.

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improve the performance of:

Vacuum Towers • Distillation Equipment • Gas Absorbers • Scrubbers • Evaporators • Separators, Knock-Out, or Steam Drums

HOW TO ORDER

Send details on type of process vessel or operation, vapor flow rate, pressure, temperature, and density or molecular weight; approximate amount of entrained liquid, viscosity, and specific gravity. Furnish drawing or sketch, if possible.

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Take a piston. Its place of business in a CAT® Diesel Engine is in the "heat zone"—up to 3600° F. Here's where some substitute pistons soften, crack and burn through. But not a genuine Caterpillar piston. Copper, nickel and magnesium are alloyed with aluminum to maintain hardness and strength under these high temperatures. Yet, the special aluminum alloy retains the high weight-to-strength ratio and heat conductivity of aluminum. With a substitute, can you be *sure*? Better see your Caterpillar Dealer for parts you can trust!

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

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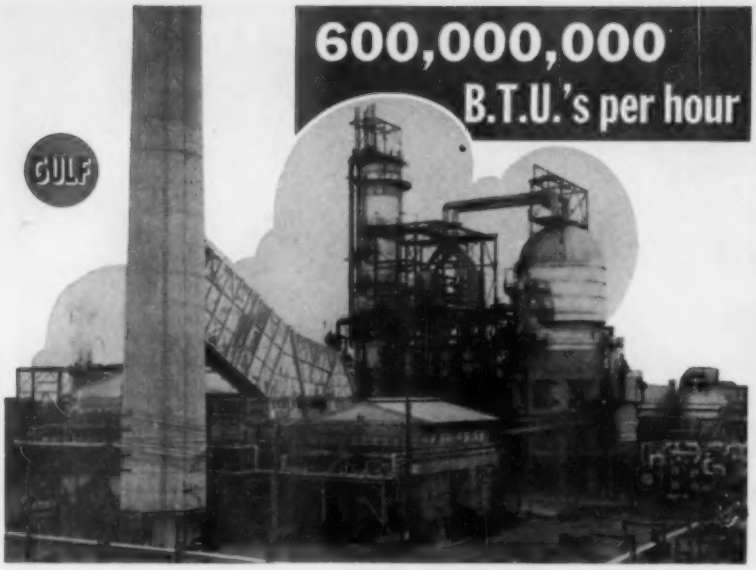

Forty-eight NATIONAL AIROIL Tandem Units fire Gulf's huge Crude Heater at Philadelphia.

with NATIONAL AIROIL'S *Exclusive* TANDEM COMBUSTION UNITS

This tremendous Combination Atmospheric—Vacuum Crude Heater at Gulf Oil Corporation's Philadelphia Refinery, was constructed by Foster Wheeler Corporation . . . for a total burner liberation of up to 600,000,000 B.T.U.'s per hour.

NATIONAL AIROIL *exclusive* Tandem Combustion Units achieve this capacity with maximum economy and availability.

These NATIONAL AIROIL oil burners are *all-alloy* for burning high temperature pitch separately, or in conjunction with non-aerated gas burners. Additional burners are also provided for waste gas disposal.

NATIONAL AIROIL Tandem Units are recognized as standard firing equipment in oil refinery and chemical plant heaters throughout the world. They are noted for versatility regarding fuels; and insure correct flame placement so necessary to avoid damage to the heat-absorbing tubes. Your furnace maintenance problems are measurably reduced, and hours on stream greatly increased by use of Tandem Combustion Units.

Further information sent upon request on your letterhead.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes; STEAM ATOMIZING OIL BURNERS; MOTOR-DRIVEN ROTARY OIL BURNERS; MECHANICAL PRESSURE ATOMIZING OIL BURNERS; LOW AIR PRESSURE OIL BURNERS; GAS BURNERS; COMBINATION GAS and OIL BURNERS; AUTOMATIC OIL BURNERS, for small process furnaces and heating plants; FUEL OIL HEATERS; FUEL OIL PUMPING and HEATING UNITS; FURNACE RELIEF DOORS; AIR INTAKE DOORS; OBSERVATION PORTS; SPECIAL REFRACTORY SHAPES.

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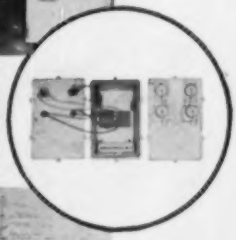
America's critical northern defense projects, the DEW line and White Alice, are reaching completion. Hughey & Phillips helped Western Electric and the Blaw Knox Companies solve severe requirements by engineering and fabricating complete ready-to-install kits.
These kits include

- **SLEET MELTER POWER & CONTROL CIRCUITS**
- **SPECIAL LIGHTING AND CONTROL CIRCUITS**
- **TOWER OBSTRUCTION LIGHTING**
- **LAMP FAILURE ALARM SYSTEMS**
- **EMERGENCY TELEPHONE CIRCUITS**

This practical experience and knowledge is available to you in solving problems in these or similar systems employing photo-electric control units, beacon flashers, obstruction lamp failure indicator and controls. Complete systems will be engineered, fabricated and packaged in a kit for your *specific* job.

System being packaged for shipment

Special junction boxes with terminals and cable support, engineered specifically for your job.



Complete installation information and diagrams are included in each ready-to-install kit.

Write today for information regarding your specific problems.

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Manufacturers of
300MM Beacons, Obstruction Lights, Photo-Electric Controls, Beacon Flashers, Special Junction Boxes, Microwave Tower Light Control & Alarm Systems, and complete kits for: Tower Lighting, Sleet Melter Power & Control.
3200 N. SAN FERNANDO BLVD.
BURBANK, CALIFORNIA

dual-fuel system is suited for automatically switching from natural gas to L.P.-gas or vice versa, the maker says.

The installation consists of two fuel regulators. Each is specifically designed to operate on either high or low B.t.u. fuels. When the pressure of either fuel drops below a certain point or is shut off, the regulators automatically change over to operate the engine on the alternate fuel. When pressure builds up, the engine automatically returns to the use of the first fuel.

The regulators are available in 1 or 2-in. sizes with carburetors to match. They will cover most horsepower requirements. **Write or call: Ensign Carburetor Co., P. O. Box 415, 1551 East Orangethorpe Avenue, Fullerton, Calif., for details on automatic fuel system.**

•

New Swivel Rated At 500 Tons

Called the Tru-Line 500, the new swivel also features a quick change floating - washpipe assembly. It's designed for deep, severe drilling conditions.

A separate ball up-thrust bearing relieves the alignment bearings of extra loads so they maintain true alignment —even during severe drilling conditions or when the swivel is put into the rathole, the maker says.

The main bearing is a heavy-duty tapered-roller type which supports the weight of the drill string. All bearings are fully oil-bathed. Oil seals protect the lubricant from contamination.

An advantage cited for the quick-change washpipe assembly is that it allows fast replacement of the washpipe and packing without uncoupling the rotary hose, removing the gooseneck, or removing bolts. The floating washpipe mounts in a rubber ring which allows enough play for the washpipe to align itself continually with the packing. This eliminates one of the major sources of washpipe and packing wear, the maker says. **Write or call: Ideco, One of the Dresser Industries, P. O. Box 1331, Dallas 21, Tex., for details on Tru-Line 500 swivel.**

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Unexcelled . . . for Outdoor Use

- DRIP PROOF
- VERMIN PROOF
- MOISTURE PROOF
- CORROSION RESISTANT
- FORCED AIR COOLED

All these features of Fieldmaster Ball Bearing Motors have been designed to overcome the rugged conditions of Oil Field requirements.

FIELDMASTER

CHECK THESE OUTSTANDING ADVANTAGES.

Heavy Cast base for alignment, stability, heavy duty, double-shielded, prelubricated bearings, reduces lubrication worries, high grade silicon steel in the magnetic circuit reduces iron losses . . . Wide variety of windings provides triple ratings, dual voltages . . . high torque licks heavy starting problems. High slip is available to take care of reciprocating load requirements encountered in pumping.

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Manufactured by VALLEY ELECTRIC CORPORATION, St. Louis, 8, Mo.

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Vapor Conservation, Fire Prevention and Accessory Equipment for Bulk Storage Tanks

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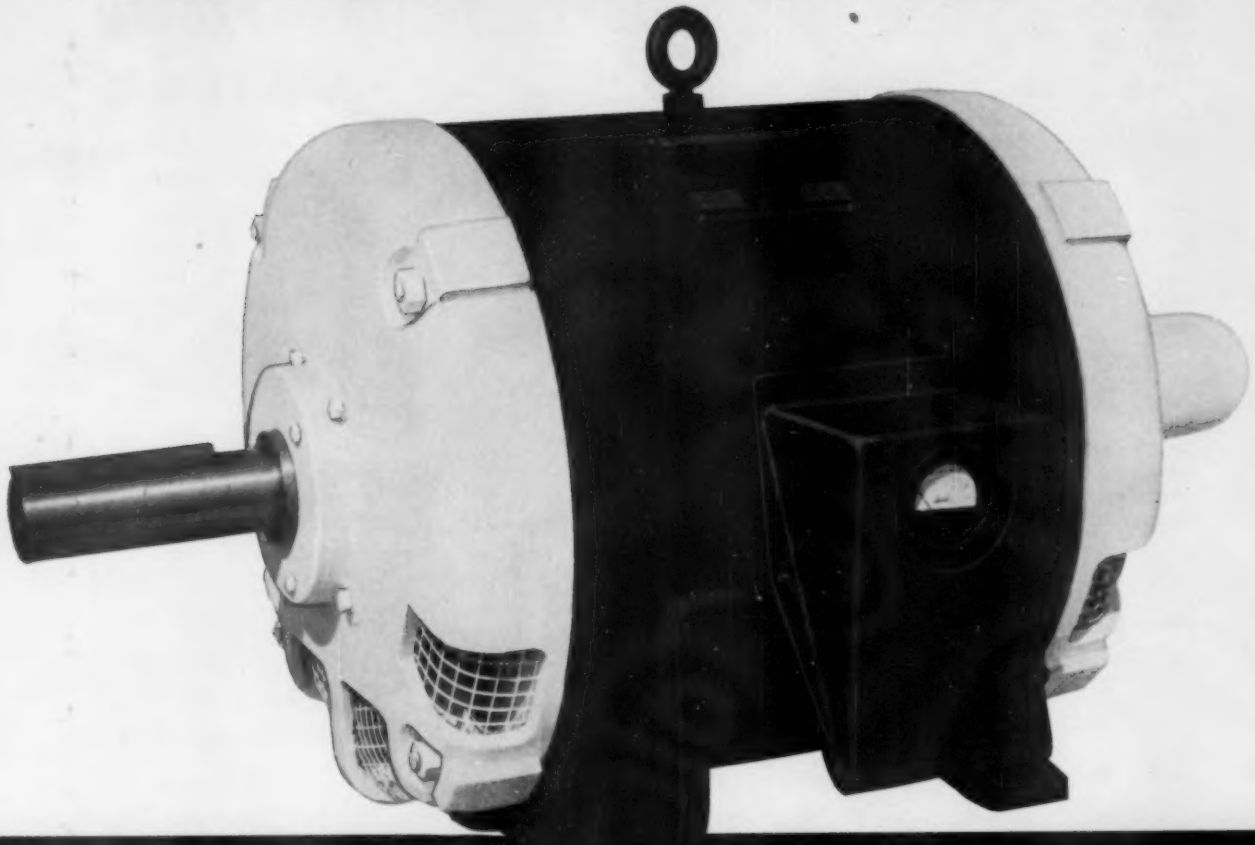
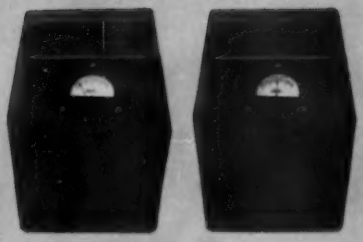


GREEN TRIANGLE ELECTRIC MOTOR

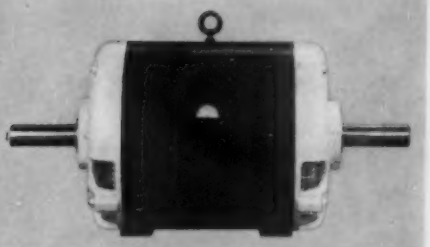
IT'S NEW.. ***it's the first electric motor designed exclusively for oil field pumping!*** Continental-Emsco solved your pumping power problems before, with the popular C-E gas engine. And now since natural gas has become more valuable, electric power more accessible and automatic on-and-off pumping control a necessity, Continental-Emsco has designed a *real* oil field electric pumping motor . . as dependable as C-E gas engines. So whatever your power source you can be assured of an electric or gas power unit from C-E *strictly oil field* from the base up . . not a model adapted from another industry . . converted to oil field use.

C-E GREEN TRIANGLE CONTROLS have been developed with exclusive *oil field features* as companion equipment for these motors.



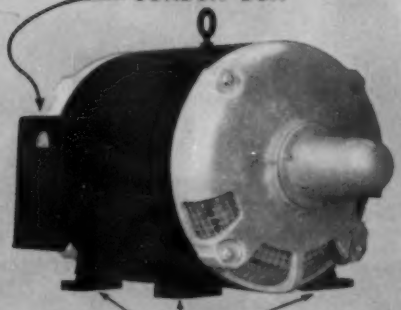
NEEDLE VARIATIONS DURING STROKE

BALANCE METER



TWO SHAFT EXTENSIONS

OVERSIZED DIAGONALLY SPLIT CONDUIT BOX



MOUNTING BOLT HOLES—SAME SIZE FOR ALL MODELS

IT'S NEW.. *the Built-in Balance Meter*

By watching the needle on this dial, field men can see *at a glance* if the unit is operating satisfactorily. Uniform readings mean no trouble, but needle peaking unevenly, means trouble . . a parted rod string . . an unseated pump . . paraffin deposits . . or some other problem. The Balance Meter gives an accurate gauge for balancing the well, too. It assures maximum lifting efficiency with power costs lower than with motors that impose excessive electrical current peak requirements. Pumpers can check the operation of Continental-Emsco motors by viewing the action of the Balance Meter needle . . an engineer with a special electrical instrument is not required.

IT'S NEW.. *Double Shaft Extension*

Two shaft extensions make C-E Green Triangle Electric Pumping Motors more flexible . . easier to install. They drive from both sides . . rotate in either direction . . leads enter on one side or the other as desired. Unit pumpers can be driven from one side of the motor and auxiliary equipment such as pumps, chemical feeders and air compressors can be operated from the opposite side without disturbing the unit pumper drive. A cover protects the shaft not in use.

IT'S NEW.. *High Slip.. High Starting Torque With a Service Factor*

C-E Green Triangle Electric Pumping Motors have 5-8% slip . . 275% starting torque . . 40° C rise combined with a guaranteed 1.15 service factor. These characteristics give cushioned peak demands and added protection to gears . . belts . . bearings . . well equipment.

IT'S NEW.. *Bolt Hole Size.. Same for All Motors*

C-E Green Triangle Electric Pumping Motors have standard 21/32" bolt holes on *all* models. This eliminates costly delays, since bolts furnished with the unit pumper can be used . . regardless of make or manufacturer.

IT'S NEW.. *Air Cooling System*

Generous air volume is pulled through these motors to keep windings cool . . not just the case. Air direction is changed by baffles, which assure a clean motor . . dust and dirt particles hitting the baffles fall and are spun out by action of the centrifugal blower fan.

IT'S NEW.. *Oversized Conduit Box*

No more "skinned knuckles" here . . plenty of room and diagonally split design makes hooking-up easy.

IT'S NEW.. *Weather-Guarded Frame*

Frame design provides complete protection against heat, dust and moisture. Steel supporting feet can be repaired in the field by welding. Varnished windings coated with Irvington 32 sealer enamel.

Continental-Emsco Green Triangle Electric Pumping Motors operate at 1200 r.p.m. (synchronous) and are available in sizes from 3 through 30 horsepower. See them at your C-E store or ask your C-E representative for complete information.

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D+B

Specialists..Parts.. and Service Keep Your Wells Producing

Continental-Emsco D+B pump repairmen are located in C-E pump shops near your producing wells. They have a thorough knowledge of subsurface pumps, regardless of make or manufacturer. D+B specialists are company trained and seasoned by day-to-day contacts with the pump problems of their area. They are furnished the best in pump shop equipment . . much of it designed and built to C-E specifications. Let us repair your pump with D+B replacement parts . . *the best buy of the industry* with our field pick-up and delivery.

.. Service th

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Your Continental-Emsco Man Can Cut Production Costs with the Right

D+B SUCKER ROD

When planning to put a well on the pump, rely upon the experience of your Continental-Emsco man. Day-by-day contacts with the producing wells of the area give him invaluable experience on the proper size and grade of D+B sucker rods and other subsurface equipment to use in your wells. When you rely on Continental-Emsco, costly equipment failures are reduced to a minimum. Talk to your D+B man.. he has the answers for lower pumping costs.

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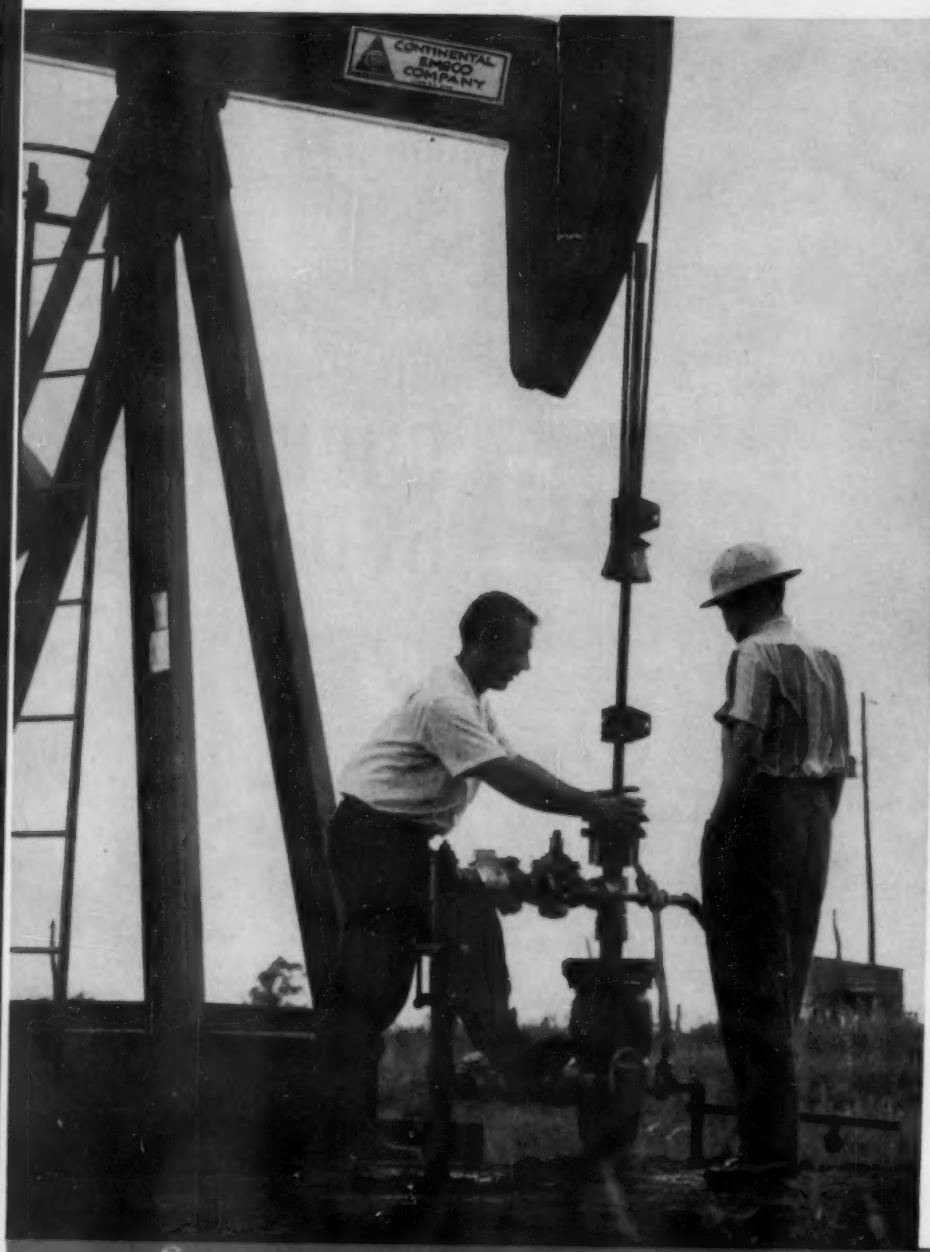

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C-E Service Backs Up Every Continental-Emsco Pumping Engine

Proper maintenance will keep your Continental-Emsco engine running for years . . but emergencies do arise. It's here that your trained C-E serviceman steps in. His intimate knowledge of C-E engines makes it possible for him to analyze the problem and make repairs quickly. Continental-Emsco stores . . backed by warehouse stocks . . have repair parts for C-E engines in producing areas, everywhere.

-Location Service

eps Your Unit Pumper mming

nental-Emsco field representatives are s eager to familiarize your operating per- l with the maintenance of C-E unit ers. They *know* these units. They can show people how to obtain efficient operating s . . demonstrate counterbalancing . . and on well and equipment performances. to rely upon your C-E man . . he'll help void trouble and in emergencies, prevent prolonged shutdowns. His services crease production profits.

.. Proper Maintenance Can Mean Longer V-Belt Life, Too

Correct V-belt tension extends the life of the belt and eliminates power-loss due to belt slippage. Your Continental-Emsco field representative will be glad to show you how to make these adjustments. Ask him, too, about GREEN TRIANGLE V-belts . . the belt designed, engineered and built exclusively for rugged oil field use by New York Belting and Packing Company, America's foremost producers of industrial rubber goods.

"V-Belt Guide for Pumping Units" will give many pointers on proper maintenance for V-belts. Write Continental-Emsco or get your personal copy from your Continental-Emsco representative.

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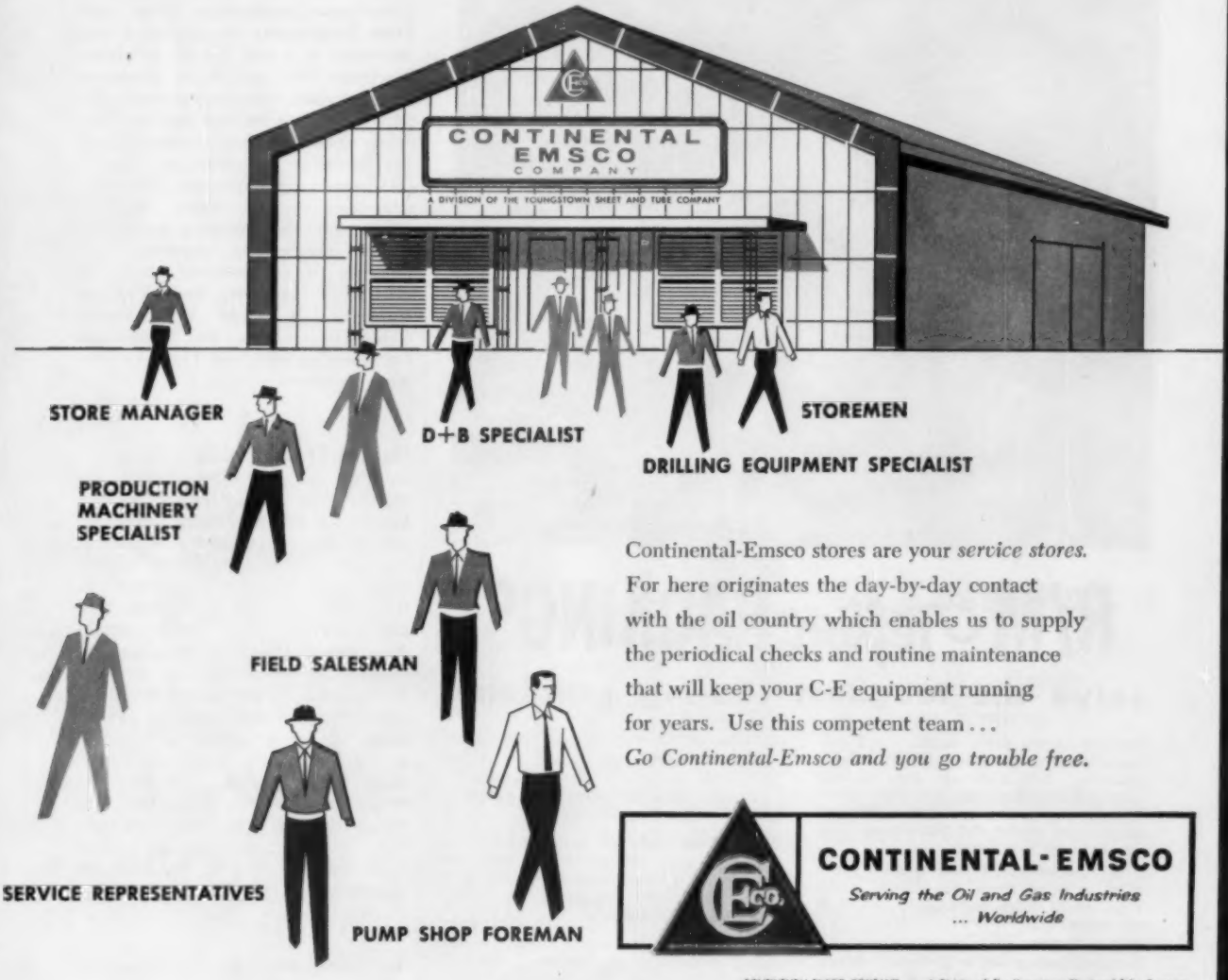
A Service Team to Keep Your Equipment Humming



Continental-Emsco stores are your *service stores.* For here originates the day-by-day contact with the oil country which enables us to supply the periodical checks and routine maintenance that will keep your C-E equipment running for years. Use this competent team . . . *Go Continental-Emsco and you go trouble free.*

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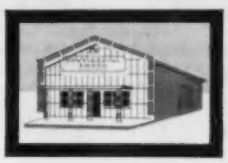

P728

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solve the toughest sealing problems

Hard-to-handle acids, caustics and solvents are no problem with R/M "Teflon" packings. Not only do they outlast conventional packings, but their effective sealing action and low coefficient of friction make the equipment they are used on last longer, too.

R/M's complete line of "Teflon" products includes these mechanical packings, all of them particularly useful in oil refineries:

R/M No. 840SW—High grade asbestos yarn packings impregnated with "Teflon" suspensoid. For use in valves handling solvents.

R/M No. 843—Made by extruding a plastic mix of "Teflon" and other compounds into an open cotton-braided jacket. For use in pumps handling dilute acids and chemicals.

R/M No. 847—A braided and cross-locked "Teflon" filament packing, dry except for impregnation with "Teflon" suspensoid. For valves handling solvents, strong acids, and corrosive fluids.

R/M No. 848—Like No. 847, except that the dry packing is lubricated with a high-temperature, chemical-resistant material. For use on pumps handling concentrated acids, slurries and solvents.

R/M engineers have amassed valuable experience in blending "Teflon" with asbestos and many other hard-to-handle materials. They will be glad to work with you on any of your special packing problems. Write today for booklet on R/M "Teflon" packings.

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS—including Vee-Flex, Vee-Square, Universal Plastic, and "versi-pak"*; GASKET MATERIALS, "TEFLON"* PRODUCTS. SEE YOUR R/M DISTRIBUTOR

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RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

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SHOWCASE . . .

New Literature

Centrifugal-Compression Stills and Flash Evaporators are described and illustrated in a new 8-page, full-color brochure. The publication illustrates and describes vapor-compression apparatus. It also reviews the more recently developed flash evaporator and the centrifugal-compression still. It lists models and capacities, giving approximate weight, space requirements, and other pertinent data. Flow sheets, diagramatic material, and photographs are included. **Write or call: Evaporator Div., Badger Manufacturing Co., 230 Bent Street, Cambridge, Mass., for Centrifugal Compression Stills and Flash Evaporators Brochure.**

•

Electrode Pocket Guide ADC 650G features an electrode-consumption calculator in tabular form. This provides data for calculating consumption per linear foot in the welding of various types of joints. The 70-page guide describes each Airco electrode, its color code, its application, and the procedure for its use in welding. Weld-metal chemical analyses and mechanical properties are outlined. Information as the factors which determine electrode selection, industrial, and government specifications for filler metals, and testing of deposited weld metal is also discussed. **Write or call: Air Reduction Sales Co., Div. of Air Reduction Co., Inc., 150 East Forty-Second Street, New York 17, N. Y., for Electrode Guide ADC 650G.**

•

Dual-Zone Pumping Brochure 5702 compiles selection charts, and schematic drawings of rod and tubing assemblies and packoff-sub assemblies. The 16-page illustrated booklet is published to assist in the proper design of dual-zone installations. **Write or call: Fluid Packed Pump Co., 9100 South Norwalk Boulevard, Los Nietos, Calif., for Bulletin 5702.**

•

Jet Bit Drilling Hydraulics Bulletin 1005 presents a series of easily read two-color graphs and charts that will solve the flow resistance problems most commonly encountered with jet bits. Basic subjects covered in the 40-page bulletin are: (1) annulus velocity, (2) jet velocity, (3) pressure loss in drill pipe, (4) viscosity correction, (5) loss at contraction in pipe, (6) loss

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Christensen constantly seeks new applications and designs to increase performance and lower footage costs. Christensen diamond equipment is proved by thorough, exhausting trials . . . not only under laboratory situations but also under actual field conditions. Christensen solves your problems by working where the problems are . . .

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These diamond bit designs, a result of Christensen research, are now standard tools of the oil industry.

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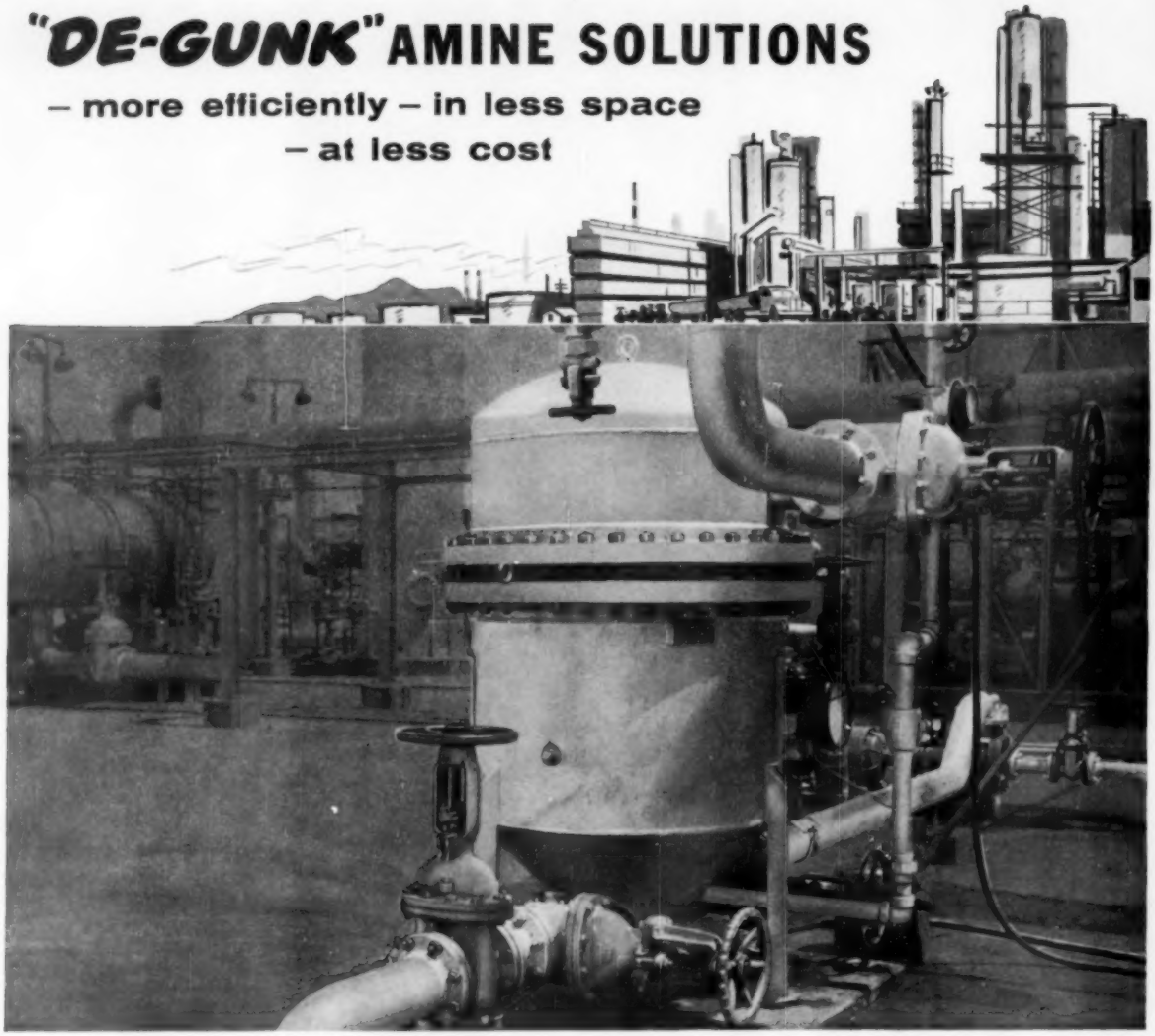

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at jet nozzle, (7) pressure loss in annulus, (8) loss at contraction in annulus, (9) mud weight correction, (10) pump output, and (11) hydraulic horsepower. In addition, a number of perforated computation forms are bound into the book to simplify calculations. **Write or call: Chicago Pneumatic Tool Co., P. O. Box 1990, Fort Worth, Tex., for Bulletin 1005.**

●

Plant Facilities of the Dallas Tank Co. are shown in a new folder. It illustrates the scope of the custom fabrication division. Complete engineering service is offered with field erection dismantling, and reerection. The folder states that special techniques are applied to the fabrication of metallic pressure and vacuum vessels. **Write or call: Dallas Tank Co., Inc., Dallas 22, Tex., for folder on plant facilities.**

●

Chemical Coatings for the oil industry are introduced in a new brochure. The bulletin features Koropon finishes, a series of chemical coatings specially engineered to combat corrosion. They are designed for protection of oil refinery equipment, pipelines, and other installations requiring chemical resistance, toughness, and adhesion. **Write or call: DeSoto Paint & Varnish Co., Box 186, Garland, Tex., for brochure on Koropon finishes.**

●

Variable Speed V-Belt Catalog and reference handbook has been made available. The 14-page catalog gives cross-reference information on every variable-speed V-belt for every type or make of unit. It also contains complete interchange listings, including drive data and part number listings of the manufacturers. **Write or call: Dayton Rubber Co., 925 Slocum Street, Dallas, Tex., for variable-speed V-belt catalog.**

●

Para-Flex—A Flexible-Cushion Coupling—is introduced in new 12-page Bulletin A-669. The brochure explains how the coupling, by means of rubber tire element, accommodates angular misalignment, parallel misalignment, and end float—singly or in any combination. It also cushions shock loads and diminishes torsional vibration. Full-view and cutaway photographs and drawings illustrate construction and installation features. Tables list engineering data to facilitate selection of couplings. The back of the bulletin shows other products in the Dodge line of power-transmis-

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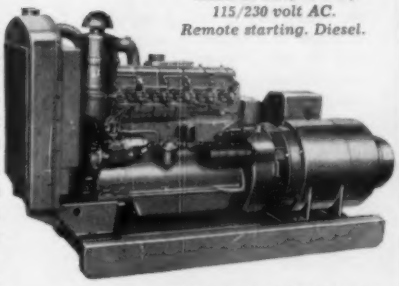
Sole supply and stand-by models for all oil field applications

Gasoline and Diesel

Diesel models for offshore service include 10 to 35 KW sizes for rig lights, floodlights, power tools, 10 and 20 KW models for offshore exploration, quarter boat lights and galley equipment . . . Air-cooled portable plants, 500 watts to 5000 watts for seismograph equipment, geophysical survey trucks . . . Gasoline or gas operated liquid cooled models, 2 to 50 KW for other applications . . . Also automatic standby plants for tank farms and refineries. Write for folder 6-H.



Model 35R061, 35 KW, 115/230 volt AC. Remote starting. Diesel.

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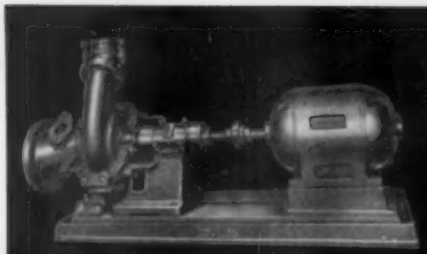
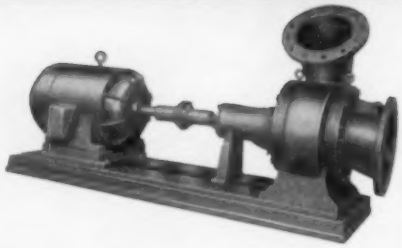


Fig. 3135 single-stage paper stock pump. Centerline discharge and self-venting casing provide steady flow without binding. Non-clogging impeller with back wall ejector vanes. Handles slurries. Twelve sizes; capacities to 6400 GPM, heads to 215 ft.

Fig. 3138-39. Specially designed for heavy duty service, pumping corrosive or noncorrosive liquids, with or without solids in suspension. Vertically split casing, "back pull-out" design. Four sizes; capacities to 9000 GPM, heads to 160 ft.



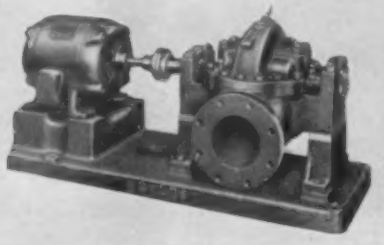


Fig. 3405 single-stage, double-suction pump. All sizes and pump combinations based on only 3 shaft and bearing assemblies. Mechanical seals or stuffing boxes. Rotation can be changed in field. Thirty-three sizes; capacities to 6400 GPM, heads to 425 ft.

GET QUICK ANSWERS TO CORROSIVE PUMPING PROBLEMS

You can solve corrosive pumping problems quickly because a number of Goulds centrifugal pumps now come in a wide range of special metals.

You can get them with fluid ends in your choice of the special metals listed below. Just match the special metal to your pumping problem.

All Bronze
Type 2 Ni-Resist
All Iron
Bronze Fitted
Nickel Aluminum Bronze
Steel and Steel Alloys

What's more, you'll get prompt delivery on these pumps (or any of four other types) in corrosion-resistant constructions from Goulds foundries.

You can keep spare parts inventory low, and meet quick changes in process requirements because Goulds pumps are designed with standardized parts for easy interchange between sizes.

Bulletin 5252-J has brief descriptions of these pumps (and the Goulds-Pfaudler *glassed* pump). Write for a copy.

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PHILADELPHIA, 2099 North 63rd St.
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In Canada: The A. R. Williams Machinery Co., Ltd.... in all principal cities

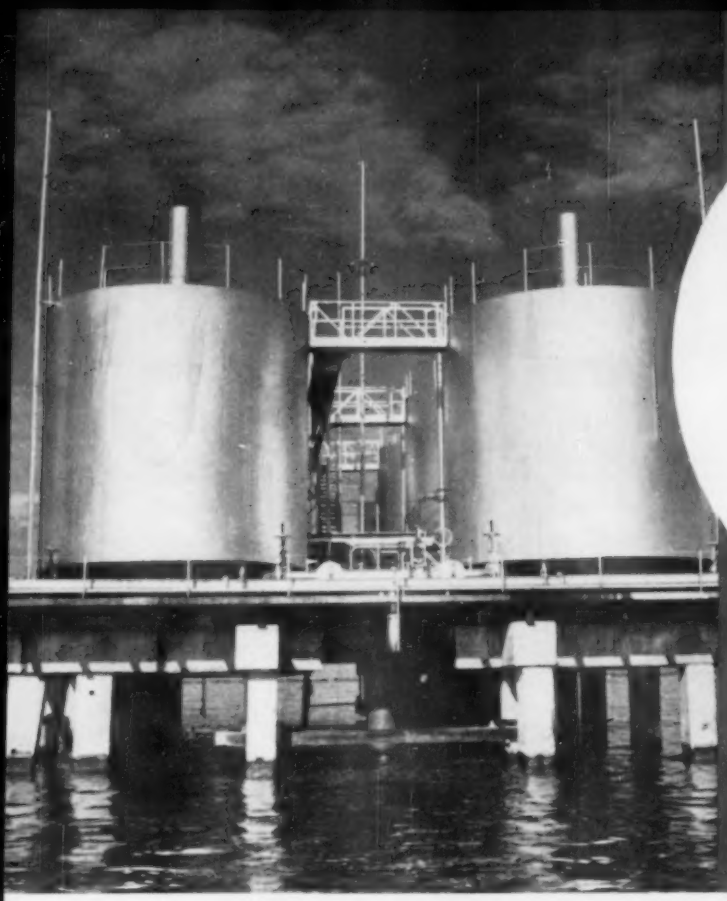
sion equipment. **Write or call: Dodge Mfg. Corp., Mishawaka, Ind., for Bulletin A-669.**

●

Maintenance Guide for Tractor Operators containing helpful hints for obtaining optimum service life from Caterpillar equipment is now available. Methods of preventing abnormal track wear are discussed in detail. Specific directions show operators how to keep steering clutches, hydraulic boosters, control levers, and brake components in best working order. The guide discusses additive oils, the service meter, filter elements, and proper methods for lubricating track rollers and idlers. Service of tractor cooling systems is shown. Detailed drawings show the best methods of servicing precleaners and air cleaners. The guide also offers several tips for periodic inspection of turbochargers. A list of general facts are given for starting and stopping tractors, purchase of fuels, stopping the diesel engine, working adjustments and daily care. **Write or call: Caterpillar Tractor Co., 600 West Washington, East Peoria 8, Ill., for Maintenance Guide 32395.**

●

Welding Data Book TIS 2575A—featuring simplified welding procedures for every base metal—is now available. The 180-page pocket-size book covers 120 welding rods, electrodes, and welding compounds. It is a guide to improved torch and metallic-arc welding, brazing, and soldering. Special welding applications such as joints with high electrical conductivity, resistance to chemicals, tinning and plating are covered. Data are also given on methods of gouging, chamfering, and removing of unwanted metal without special equipment. Weld preparation steps are given for all metals. The welding procedures presented stress ways to save dismantling, pre and postheating. Procedures given also tell how to get maximum machinability, how to get color matching deposits, how to increase weld strengths and cut down on both amount of alloy used and finishing time and work. The best torch adjustments and electrode position and manipulation are a feature. Improved results through the use of correct fluxes is explained alloy-by-alloy. Descriptions of more than 60 Eutectic low-temperature welding alloys give the welder a useful alloy-selection guide. **Write or call: Eutectic Welding Alloys Corp., 40-40 172 Street, Flushing 58, N. Y., for Welding Data Book TIS 2575A.**



"Finest Packaging of Tank Steel We Have Ever Received"

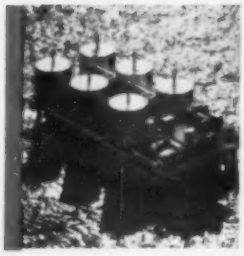
WELDED STEEL TANKS

MASTER-CRAFTED BY

COLUMBIAN

SINCE 1893

A Columbian shipment of master-crafted tank plates was quickly welded into six tight oil tanks at Creole Petroleum Corporation's Lake Maracaibo, Venezuela, site. Columbian Tanks serve at countless out-of-the-way places, at home and abroad.



Steamship, rail and truck lines like Columbian packaging, too. Ease in stacking and handling often means faster transportation.

Want to know more about what makes Columbian Tanks tight? Send for unusual new Tank handbook of facts, pictures and specifications.

In a recent letter to Columbian, Morrison-Knutsen Co., Inc., internationally known contractors and engineers, said:

> **"We wish to compliment your organization on the excellent packaging. It is undoubtedly the finest packaging of tank steel we have ever received."**

Oil is where you find it . . . and sometimes that's in very inaccessible places! Bringing modern steel storage into areas of rugged terrain where transportation is difficult, can present real problems. Damage in transit can cause costly delay.

Columbian makes a specialty of safe packaging and shipment of precision-made Columbian tank plates because only plates that arrive absolutely true to their factory-formed radius can be quickly welded or bolted—in the field—into the absolutely tight tanks for which Columbian is famous.

It pays in more ways than one to specify Columbian and to contact your nearest Columbian distributor, listed below.

COLORADO
O'Neill Tank Co.
Sterling

KANSAS
O'Neill Tank Co.
Box 771, Great Bend
Hays
Hill City
Meade

LOUISIANA
McGuffin Tank Co.
Box 724, Shreveport
McClatchey Tank & Supply Co.
Lafayette

NEBRASKA
O'Neill Tank Co.
Kimball

NEW MEXICO
Allied Supply Co.
Box 217, Artesia
American Tank & Steel Co.
Box 1177, Farmington

TEXAS
Gray-Brown Tank Co.
Box 924, Longview
Mapp Tank Co.
Box 1349, Odessa
Texas Gulf Tank Co.
Box 14281, Houston
Columbian Steel Tank Co. (warehouse)
3705 McKinney Ave., Houston
Westex Tank Co.
Box 941, Odessa
B. A. Box Tank & Supply Co.
Box 547, Beeville
Martin Tank Co.
Box 135, Corsicana
Kilgore
Federal Tank Co.
Box 3367, Bellaire
Panhandle Steel Products Co.
Box 1191, Wichita Falls
Miller Tank Co.
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CANADA
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COLUMBIAN STEEL TANK CO. P. O. Box 4048-J, Kansas City, Mo.

STEEL, Master-Crafted by Columbian . . . First for Lasting Strength

Fluor Corp.'s Stock Admitted to Trading . .

on both the New York Stock Exchange and the Pacific Coast Stock Exchange. Stock of Fluor Corp., Ltd. has been sold over the counter for the past 7 years.

Fluor Products Co., a division of the parent corporation, accounts for about 10 per cent of the total business volume. Fluor has six active subsidiaries in Canada, New York City, and England. The company's main office is in Los Angeles, its Mid-Continent division in Houston. Research facilities are in Whittier, Calif., and manufacturing plants in Paola, Kans., and Santa Rosa, Calif.

National Cylinder Gas Co. Names H. D. Hartough . .

H. D. HARTOUGH

general manager of the Girdler catalyst department. According to Walter H. Girdler, Jr., vice president, Hartough will be in charge of all phases of research, development, production and application of catalysts manufactured in the firm's plant in Louisville, Ky.

Girdler catalysts are widely used in gas processing and synthesis, gas removal, hydrogenation and similar processes in the petroleum, chemical and other industries.

Since 1954 Hartough has been assistant to the general manager of Houdry Process Corp. He holds a large number of patents in the catalysts field and has written numerous papers and books. Prior to joining NCG, he did research work at the Socony-Mobil Research Laboratories and at Hercules Powder Co.

Harold Brown Co. Occupies New Facilities . .

on Milford Street, Houston. They recently moved into these larger office and plant quarters. Harold Brown Co. manufactures gas-lift, controller and plunger equipment.

National Supply Will Represent Win-Well . .

exclusively in all its foreign markets other than Canada, where Win-Well Manufacturing Co. distributes through domestic supply stores.

Initial sales efforts in the foreign field, according to W. B. Pollock, president, will be centralized in Mexico, Venezuela, European countries, Sumatra and the Middle East.

Pollock and Paul Huska, chief engineer, are planning a 2 months' tour of South America, Mexico and European oil centers to work with National Supply foreign offices in these locations.

Promotions Announced by Dallas Tank Co., Inc.

C. Edwin Ponkey, who joined the company in August as general manager and assistant to the president, has been elected president. Henri Jennings has been promoted to vice president of LPG sales, and Allen Peairs has been elected vice president of custom sales.

George Cook has also joined Dallas Tank as factory manager of its Dallas plant, according to Samuel B. Ballen, chairman of the board.

Aztec Manufacturing Co. Opens Sales Offices . .

to serve the Abilene, San Antonio and Wichita Falls areas. Doyle Ogle has recently opened the Aztec office in Abilene; new sales representative in the San Antonio area is Fred Sutton; and the Wichita Falls area is being served by Ross Howell, according to Fred Barnum, sales manager.

Before joining Aztec, Ogle had been in the oil-equipment industry for 10 years. Sutton, a veteran of 13 years in the oil-field industry, came to Aztec from Mid-Continent Supply Co. Howell has served in several capacities in the oil-field industry, with which he has been associated for many years.

Johnston Pump Co. Barrel Pumps Ready for Service . .

by Gulf Pipeline Co. in Texas. Inspecting the pumps before shipment are John Mapel, sales manager; Perry Brown, vice president in charge of production; and A. H. Miller, vice president and general manager.

The two larger pumps are designed to handle 10,500 g.p.m. at 195 ft.; the smaller units will lift the same amount from 98 ft. All pumps will be active.

Avondale Builds Series Of Barges for Creole . .

for use in the Lake Maracaibo area of Venezuela. Avondale Marine Ways, Inc. has been on an extensive construction program during this year for Creole Petroleum Corp.

Three of the barges are of the deck-cargo type, designed primarily for transportation of materials. Four other deck-cargo barges have been built for general well servicing in the

DETRICK DRAFTING DEPARTMENT, where experienced engineering is blue-printed into top efficiency heat enclosure design.

WE ARE "PACKAGERS" OF HEAT

WITH A 45-YEAR RECORD OF SERVICE TO AMERICAN INDUSTRY

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THERMOLAYER REFRACTORY LINER

For steel cased and buckstay units. Simple, fast installation. Adaptable to any contour. Low heat loss. Refractory resistance. Wide temperature range. Write for Bulletin D24.

M. H. DETRICK COMPANY

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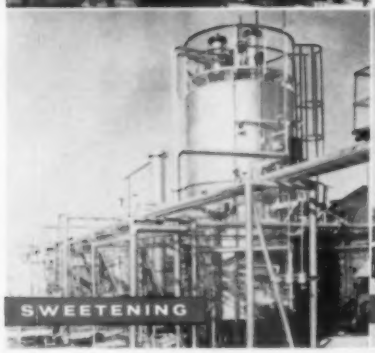
Detrick service includes engineering, materials and field inspection of the installation.

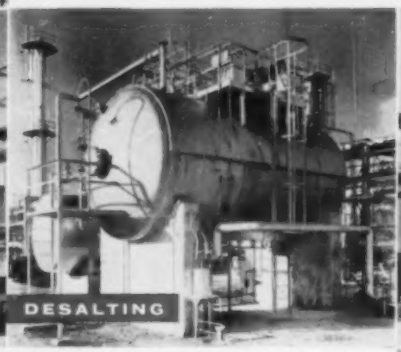
DETRICK Heat ENCLOSURES

DETRICK

HEAT ENCLOSURES

PETRECO electric processes are contributing to the AUTOMATIC CONTROL of petroleum producing and refining operations

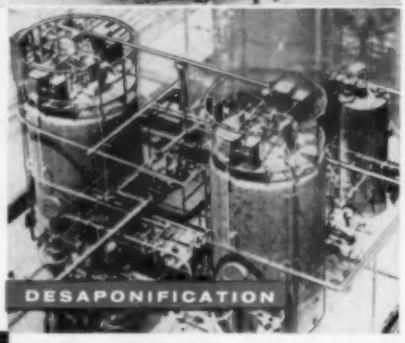


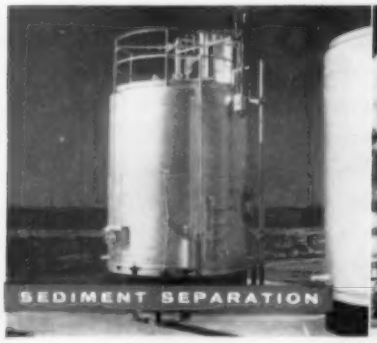


Throughout the world, Petreco electric processes are eliminating the many problems and uncertainties that used to grow out of processing guesswork.

By incorporating the advantages of automation, Petreco units are changing many a processing "art" to an exacting *science*.

Petreco designs, constructs and services electric petroleum treating equipment to perform many processing functions—automatically, continuously and with precision control.





For complete information on any or all of these processes:

- ELECTROFINING
- SWEETENING
- DESALTING
- LUBE OIL TREATING
- DESAPONIFICATION
- SEDIMENT SEPARATION
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A DIVISION OF PETROLITE CORPORATION

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DESALTING • DEHYDRATING • CAUSTIC WASHING • ACID TREATING • DOCTOR TREATING
SWEETENING • NAPHTHENIC ACID REMOVAL • SEDIMENT REMOVAL

AP-57-1

Tia Juana district of Lake Maracaibo. Three additional barges were also constructed for similar application and differ in dimensions and equipment installed. The remaining two barges are of comparable construction but will be used for cement-coating pipe on location.

H. C. Smith Oil Tool Co. Names Art Hawkins . .

ART HAWKINS

division manager, headquartering in Ventura, Calif., According to Arthur S. Marshall, vice president-sales, Hawkins joined the company in 1947, in 1953 was appointed branch manager, and in June 1957 was made assistant division manager.

Electric Steel Foundry Co. Moves Denver Office

According to Esco's district manager, Gordon Ley, the new office and warehouse is in the Mile High Industrial Center of Denver.

In the Denver area Esco represents such manufacturers as Armco Steel Corp., Carpenter Steel Co., Swepco Tube Corp., Tube Turns, B. F. Goodrich Co., Tube Turns Plastics, Inc., G. O. Carlson, Rigidized Metals Corp. and H. M. Harper.

As a distributor for these suppliers and as a high alloy casting producer, Esco offers the complete stainless package including cast, wrought and forged products. The move into the new warehouse will also make available engineering, foundry and metallurgical experience and provide fast service on stock items.

Office manager of Esco-Denver is Roy Orchard.

Lincoln Electric Co. Transfers Personnel . .

in its district offices. Bruce N. Frye goes to Columbus, Ohio, from Atlanta, Ga. Edwin Williams is transferred to Birmingham, Ala., from Atlanta, and Gerald R. Stoeckinger has joined the district office in Los Angeles.

Prior to serving 3½ years in Atlanta, Frye worked in Lincoln district offices at Kansas City, Mo., and Memphis, Tenn. He was a branch manager of sales for Dictograph Products prior to joining Lincoln.

Williams taught at the Lincoln welding school 7 years and served in

Another SOUTHERN MILL Prefabricated Home
Designed for Gracious Living

Luxury Look with Economy

This home is made up of standard STURDYBILT sections, prefabricated at the factory. With the breezeway, utility and comfort is added. STURDYBILT Prefabricated homes with a luxury look can be economically erected on your site. Write for information.

STURDYBILT PREFABRICATED, DEMOUNTABLE HOUSES

SOUTHERN MILL & MANUFACTURING CO. • TULSA, OKLAHOMA.

STURDYBILT HOUSES COMPLY WITH COMMERCIAL STANDARD CS125 OF THE NATIONAL BUREAU OF STANDARDS FOR PREFABRICATED HOMES

®NERVATAPE P.E.T.

POLYETHYLENE PRESSURE-SENSITIVE TAPE

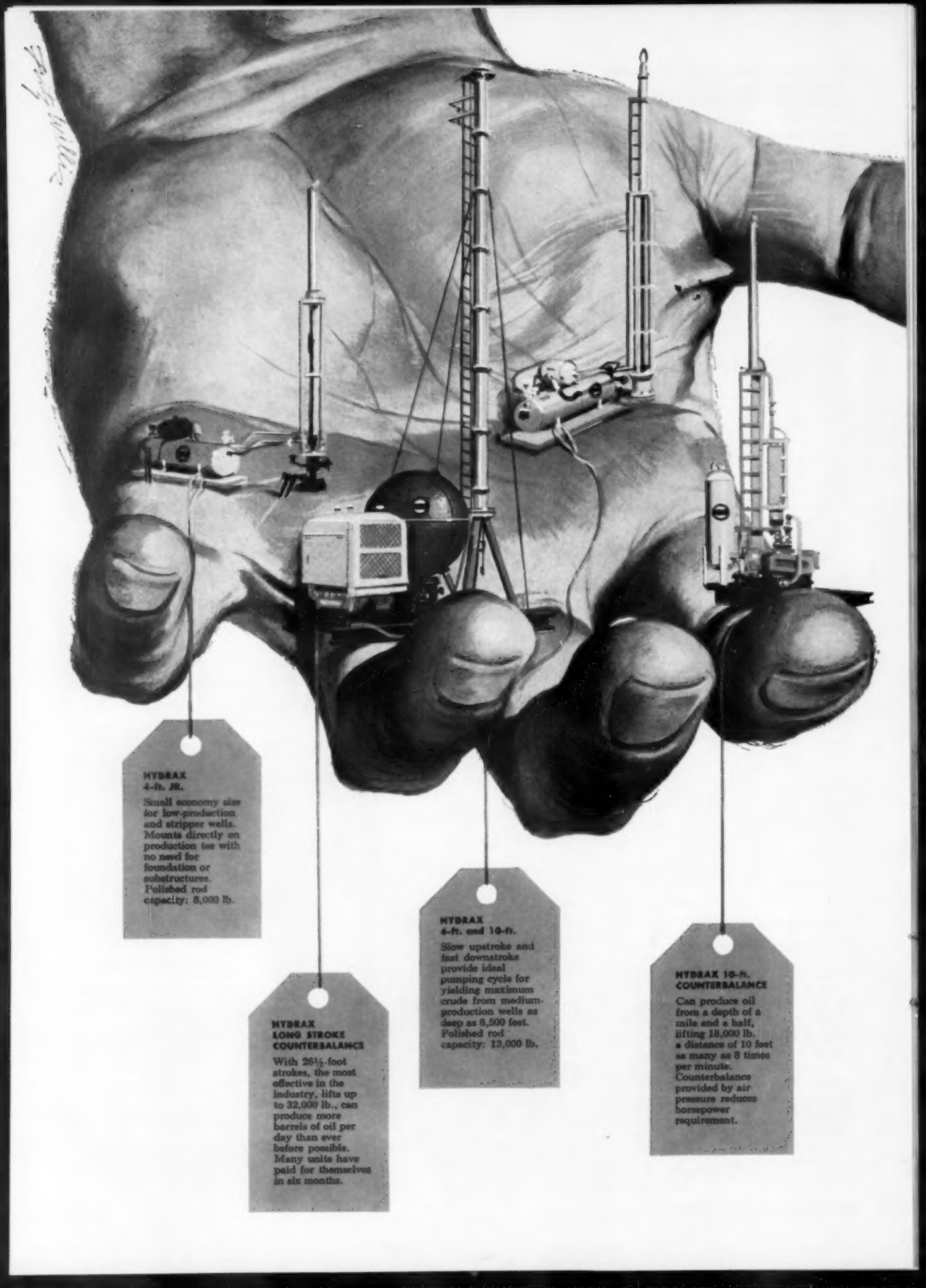
No holidays ever...
this pipe wrap stays on the job

3 EXCLUSIVE ADVANTAGES

1. The extrusion process gives NERVATAPE P.E.T. a homogeneous molecular knit, free from inner stresses and holidays.
2. The high molecular weight oriented type of plastic used in NERVATAPE insures uniform longitudinal and transverse tensile and tear strength.
3. Adhesive and backing never separate when tape is twisted or stretched.

Write for technical bulletin

RUBBER & PLASTICS COMPOUND CO., Inc.
10 Rockefeller Plaza, New York 20, N. Y.


HYDRAX
4-ft. JR.
Small economy size for low-production and stripper wells. Mounts directly on production tee with no need for foundation or substructures. Polished rod capacity: 8,000 lb.
HYDRAX
LONG STROKE
COUNTERBALANCE
With 26½-foot strokes, the most effective in the industry, lifts up to 32,000 lb., can produce more barrels of oil per day than ever before possible. Many units have paid for themselves in six months.
HYDRAX
4-ft. and 10-ft.
Slow upstroke and fast downstroke provide ideal pumping cycle for yielding maximum crude from medium-production wells as deep as 8,500 feet. Polished rod capacity: 13,000 lb.
HYDRAX 10-ft.
COUNTERBALANCE
Can produce oil from a depth of a mile and a half, lifting 18,000 lb. a distance of 10 feet as many as 8 times per minute. Counterbalance provided by air pressure reduces horsepower requirement.

FROM AXELSON...

the only complete line of hydraulic pumping units

THERE'S A HYDRAX FOR EVERY TYPE OF PRODUCTION, from shallow stripper wells to deep high-volume producers. Easy and inexpensive to install, HYDRAX units have smooth, hydraulically dampened strokes that pay off in reduced production costs:

- sucker rod life extended as much as eight times
- rod stresses safely increased as much as 30%
- greatly improved volumetric efficiency
- gas lock eliminated by high compression ratios
- less wear and tear on subsurface pumps
- less turbulence at well bottom

Every HYDRAX unit is backed by Axelson's 59 years experience in the design and manufacture of petroleum equipment (10 years in hydraulic pumpers) and by a nationwide service organization of factory-trained specialists who can be at any well site within hours.

For more information about HYDRAX, the complete family of hydraulic pumping units, call your Axelson representative or write for Bulletin PO11-H-153.

AXELSON®

AXELSON MANUFACTURING COMPANY
Division of U.S. Industries, Inc.
6160 South Boyle Avenue, Los Angeles 58, California

THOMPSON
SAND RESISTANCE
OIL WELL PUMPS

TRAVELING PLUNGER ROD TYPE BOTTOM HOLD-DOWN PUMP STANDARD SIZE

Figs. 400P, 600P, 700P, 800P

Single or double, self-aligning, combination cup and plunger or all-metal traveling plunger type, pumps made in four sizes: regular 1½", 1⅝" oversize, 2" regular and 2⅛" oversize bore. These pumps seat in API seating device. In very sandy wells, or when tubing is out, we recommend our SAND HOUSING MECHANICAL SEATING SHOE, which prevents sanding in of pumps as sand can be pumped and the pump pulled at any time by our sand flushing arrangement.

TOP HOLD DOWN INSERT ROD PUMP

Standard Size, Figs. 400T, 500T

Self-aligning double plunger insert pumps. Made in three types: combination cup and single plunger; combination cup and double self-aligning type; and metal-to-metal double plunger self-aligning type. All are equipped with Regular or Extra Long Alloy Plungers, ground individually to fit the barrels, assuring longer life on both pump and surface equipment.

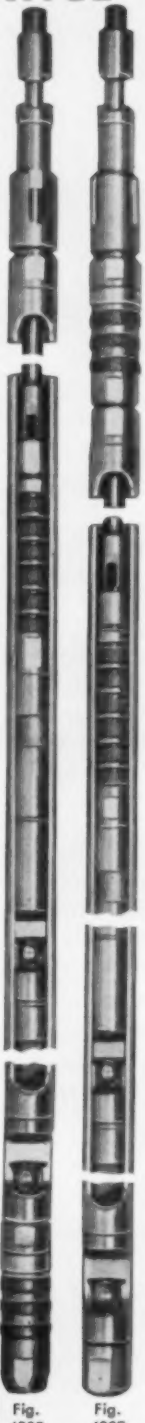
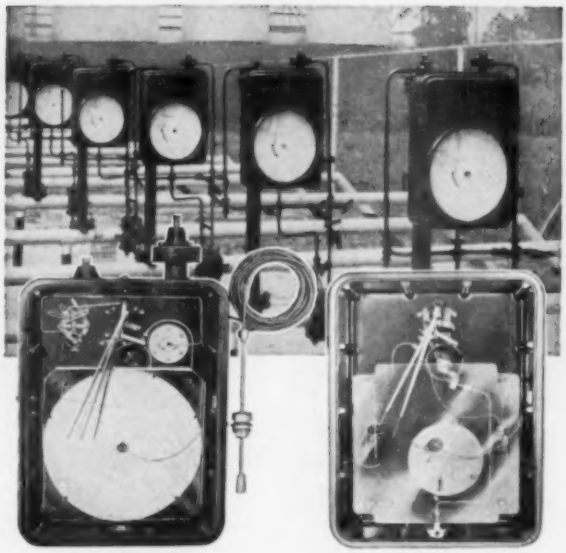


Fig. 400P 600P 700P 800P

Fig. 400T 500T

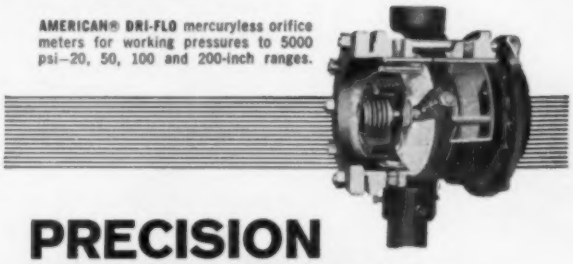
THOMPSON PUMP COMPANY
DRAWER 591
OKMULGEE, OKLA.



AMERICAN-WESTCOTT Series A-88 recording orifice meters for flow, pressure and temperature measurement—working pressures to 5000 psi—10, 20, 50, 100 and 200-inch ranges.

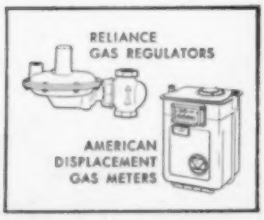
CANNON METER PENS for recording meters, available if desired, provide clear, legible chart records—hold up to a year's supply of ink.

AMERICAN® DRI-FLO mercuryless orifice meters for working pressures to 5000 psi—20, 50, 100 and 200-inch ranges.



PRECISION MEASUREMENT
of flow, temperature, and pressure on one chart

Wherever precision measurement and economy of operation are required; at high or low flow rates, at varying temperatures, whether in recording, indicating, integrating or telemetering models, American orifice meters are synonymous with accurate, dependable, trouble-free service and low maintenance costs.



AMERICAN® METER COMPANY
INCORPORATED (ESTABLISHED 1874)

GENERAL SALES OFFICE: Philadelphia 16, Pennsylvania • Albany Alhambra • Atlanta • Baltimore • Birmingham • Boston • Chicago Dallas • Denver • Erie • Houston • Kansas City • Los Angeles • Minneapolis • New York • Omaha • Pittsburgh • San Francisco • Seattle Tulsa • Wynnewood. IN CANADA: Canadian Meter Company Ltd., Milton, Ontario • Calgary • Edmonton • Regina

SUPPLIERS TO THE GAS INDUSTRY for Ironcase, Tinned Steelcase, Aluminumcase and Welded Steelcase Meters • American-Westcott Orifice Meters Instruments • Reliance Regulators • Apparatus • Valves

the Atlantic district office 3 years. Stoeckinger was a junior engineer with Wheelabrator Corp. before joining Lincoln in 1956. He completed a 1-year training course at Lincoln's Cleveland, Ohio, plant before his assignment to Los Angeles.

Hallikainen Instruments Adds E. F. Schimbor . .

E. F. SCHIMBOR

to its staff as vice president and sales manager.

Schimbor has more than 25 years' experience in the technical sales field, 15 with C. J. Tagliabue Manufacturing Co. With consolidation of offices in 1950 between Tagliabue and Weston Electrical Instrument Corp., Schimbor became sales engineer to Herman E. Held, San Francisco, manufacturers representatives for Weston. Schimbor remained with the Held company until he joined Hallikainen in September 1957.

R. W. Olson, E. O. Vetter Appointed by TI . .

as vice president of research and engineering and general manager of the industrial instrumentation division at Houston, respectively. According to P. E. Haggerty, executive vice president, Olson, a vice president of Texas Instruments, Inc. from 1951 to 1953, returns to the executive staff after serving nearly 4 years as head of the industrial instrumentation division. He will direct the planning and coordination of research and engineering activities, especially on the long-range basis. Dr. Gordon K. Teal, assistant vice president, continues as director of research in charge of the company's central research laboratories.

Vetter previously was with Geophysical Service, Inc., a TI subsidiary company, where he had been administrative vice president since 1955. He joined the staff in 1952 as controller and was promoted to assistant vice president, administration, in 1954.

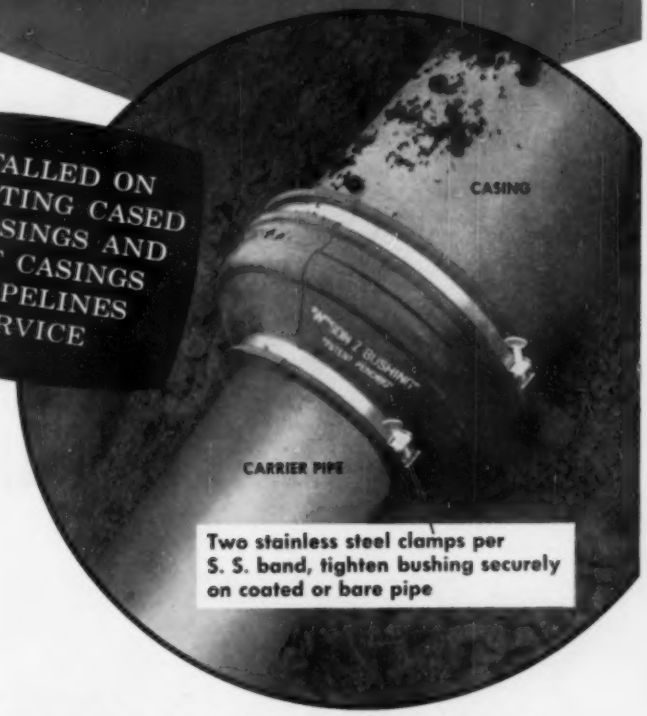
Oil Well Supply Division Names Marsh, Jenkins . .

to posts at Midland, Tex., and Red Deer, Alta, Canada, respectively. Donald L. Marsh has been named district engineer, according to William Miskimins, Central Midwest area manager of the division. James F.

They Go Together...

WmSEAL SPLICED "Z" BUSHINGS* for PIPELINES IN OPERATION

*INSTALLED ON EXISTING CASED CROSSINGS AND SPLIT CASINGS ON PIPELINES IN SERVICE



HERE'S AN EASY WAY TO INSTALL CASINGS ON LINES IN SERVICE

EVERY OTHER WmSON INSULATOR IS INSTALLED UP-SIDE-DOWN TO CENTER CASING ON PIPELINE

Interrupted torch-cut forms "hinge"—makes lineup easy for welding around pipe

Write for bulletin

Improved spliced "Z" Bushings are complete with easy to apply cold patch kit.

T.D.Williamson,Inc.

P. O. BOX 4038 TULSA 9, OKLAHOMA

REPRESENTATIVES: HOUSTON · AMARILLO · PITTSBURGH · PLAINFIELD, N. J. · JOLIET, ILL. · JACKSON, MICH. · LOS ANGELES · SAN FRANCISCO BARTLESVILLE, OKLA. · SEATTLE · EDMONTON · TORONTO · CALGARY VANCOUVER · BUENOS AIRES · CABIMAS, ZULIA, VENEZUELA · DURBAN, NATAL, SOUTH AFRICA · PARIS, FRANCE · SIDNEY, AUSTRALIA

A. B. Vaught says . . .

"We shopped around, and . . .

CARDWELL'S L-350 and its NEW FREE-STANDING MAST* more than met our requirements!"

Mr. Vaught says:

"We needed a rig that was portable and economical enough to contract-drill shallow and medium depth wells. We settled on Cardwell's L-350 with its new free-standing mast. It more than met our requirements and also gave us the deep workover and deep slim-hole drilling capacity we needed.

This is our third CARDWELL rig, and, due to the fact that repair and replacement have been practically nil on the other two, I have every confidence in the L-350 with its new free-standing mast as a lightweight, high capacity draw works."

**The unit purchased by A. B. Vaught, Midland, Texas, is a twin-engine, single-drum L-350 with rotary drive and a 15" double rotor hydromatic brake package, in combination with Cardwell's new 96' free-standing mast.*

BOX 2001

WICHITA, KANSAS U.S.A.

cardwell MANUFACTURING COMPANY

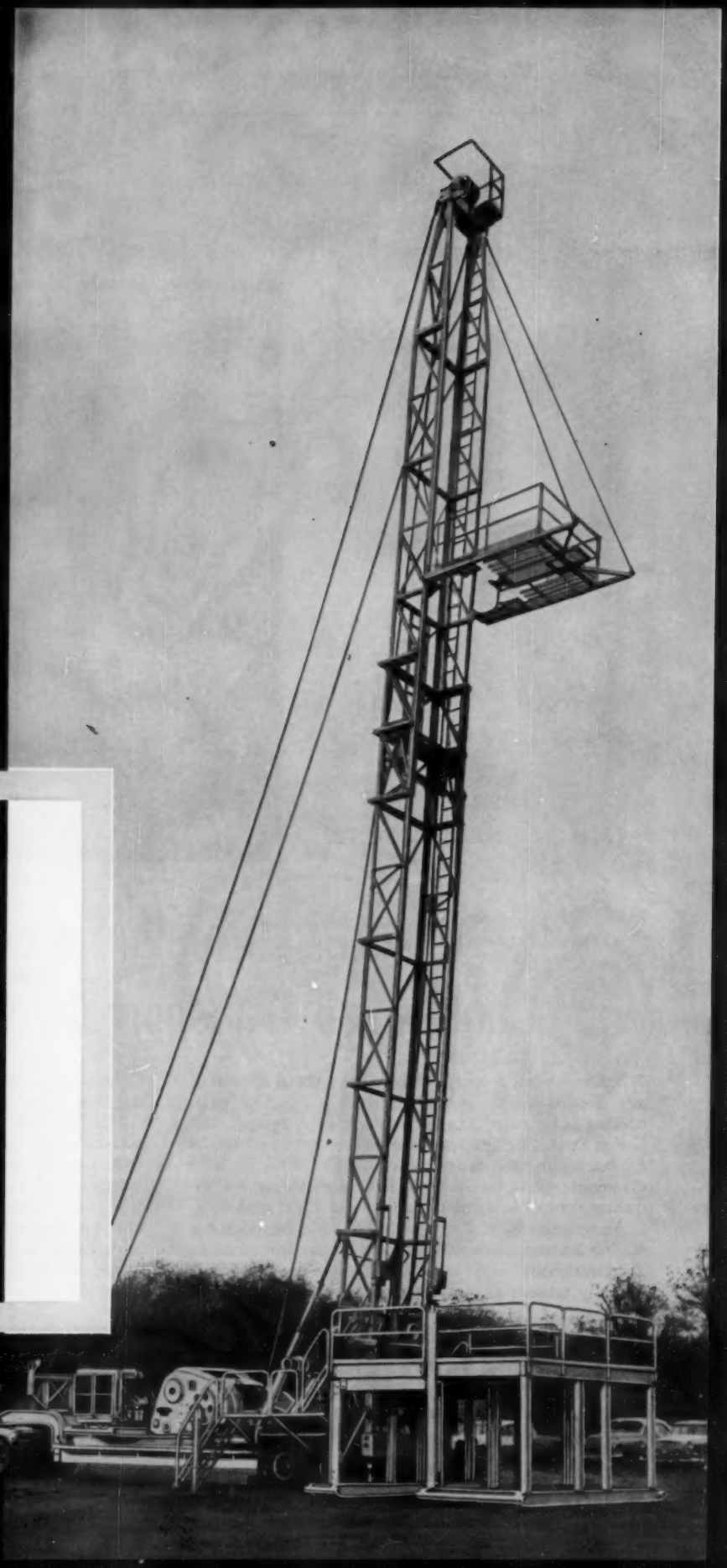
New Versatile Features

* FREE-STANDING MAST—96' mast requires no external guy lines and has a hook load capacity of 150,000 pounds.
* HYDRAULIC OPERATION—mast raises and extends and locks in position, hydraulically. No rigging-up required to raise or lower mast.
* NEW SUB-STRUCTURE allows ample working space for blow-out equipment. Sub-structure quickly assembled with tapered pins. A steel mud plate as standard equipment eliminates matting boards. Rotary table can be cradled flush to floor.
* NEW TRAILER has tandem dual axles with eight 10.00 x 20, 14-ply tires; air brakes and self-supporting walkways with steel floor plate.
* FORWARD-MOUNTED CATHEADS—Eliminate extra rope rollers and excessively long tong lines. Allows easier and safer operation.
* SINGLE LEVER CONTROLS . . . Centralized and forward mounted to give driller clear view of all drilling operations.
* HYDROMATIC BRAKE—(optional) gives smooth . . . easy control . . . 15-inch double rotor type, integrally mounted with friction engaging clutch.
* FRICTION CLUTCHES—Fawick's VC (ventilated construction) design. Exterior mounted for easy accessibility.
* CHAIN DRIVES—with positive oil bath lubrication, assure long life. Optional oil bath lubrication available for Rotary Table Drive.

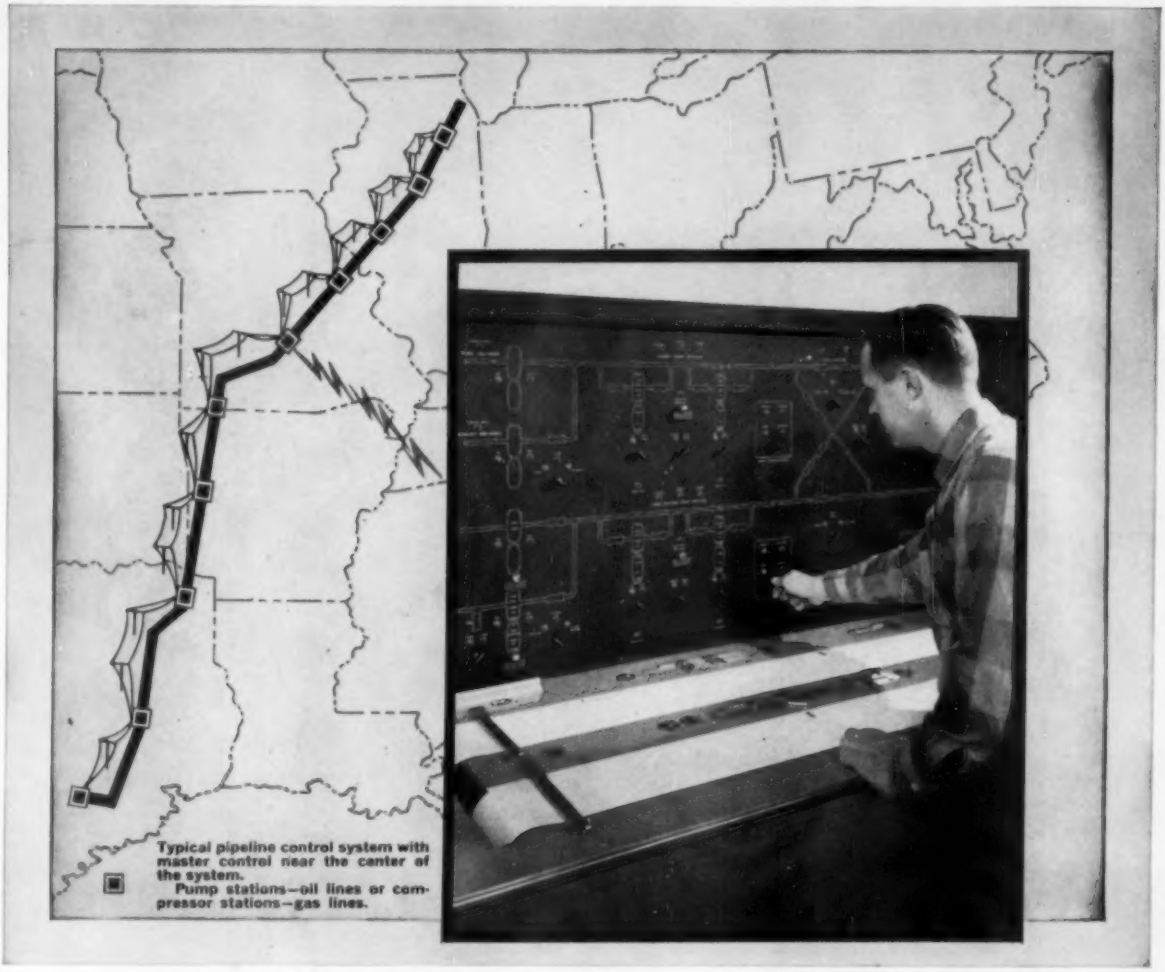
This entirely new Trailermast combination . . . using the NEW powerful L-350 draw works with a completely new mast and trailer mounting delivers power to "get the job done". Designed for low cost moves and fast rig-up and tear-down operations.

This new Cardwell combination is the L-350 single or twin engine drive draw works, mounted on the new 96' mast, with no external guy lines. Draw works has a nominal rating of 350 input horsepower. Two drum clutches, in combination with the torque converter, gives instantaneous single-lever-control over two full ranges of line speeds and pulls . . . all chain drives are oil bath lubricated.

Cardwell's new combination draw works and trailermast offers you an entirely new version of a versatile and lightweight rig.



for full information
call your nearest
cardwell
representative


Typical pipeline control system with master control near the center of the system.
Pump stations—oil lines or compressor stations—gas lines.

UNION CTC means a complete Centralized Transport Control System

When you want a *complete* pipeline control system of any desired length, specify UNION CTC. Our engineering is based on the *systems design approach*, and Union Switch & Signal is prepared to take responsibility for integrating the entire control system. This includes communications, instrumentation, telemetering, and sequence control integrated into the one CTC system.

An operator located at a central dispatching office has all the information needed to control the flow of oil or gas throughout the system. He can function as if he were actually present at each station under his supervision. Control and indication codes can be transmitted over one pair of line wires or other channel in seconds.

UNION CTC provides more efficient dispatching and more effective control of through-put with considerable reduction in operating costs. It is *not* an expensive luxury . . . it is a profit earner.

If you are planning a new pipeline or modernizing an old one, Centralized Transport Control offers definite advantages. It can be used for gathering systems, tank farms and offshore applications. Write for our Bulletin No. 1052.

UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
PITTSBURGH 18, PENNSYLVANIA

Jenkins, store manager, was transferred from Drayton Valley, Alta., it was announced by W. A. Weir, Canadian area manager.

Marsh, who joined Oilwell in 1949 at Odessa, Tex., has served as assistant district engineer at Tulsa, field engineer at Snyder, Tex., assistant district engineer at Odessa and Shreveport, La., and district engineer at Odessa and Midland. Jenkins was employed by Oilwell in 1948 at Okotoks, Alta., later served at Edmonton, was store manager at Swift Current, Sask., and later was transferred to Okotoks and Drayton Valley.

Baker Oil Tools, Inc. Announces Transfers . .

in its Central division. D. C. Lewis, former branch manager, El Campo, Tex., has been promoted to assistant district manager, Louisiana Gulf district, with headquarters in Lafayette.

D. C. LEWIS

MUCKLEROY

F. D. BEEDLES

E. L. RUNNELS

C. C. TALBOT

T. G. McBRIDE

M. C. Muckleroy, former branch manager, Corpus Christi, Tex., is promoted to district staff engineer, Southwest Texas district, headquartered in Corpus Christi. F. D. Beedles, former branch manager at Hill City, Kans., transferred to Liberal, Kans., as branch manager.

E. L. Runnels, formerly based at Hobbs, N. M., has been appointed branch manager of the new branch

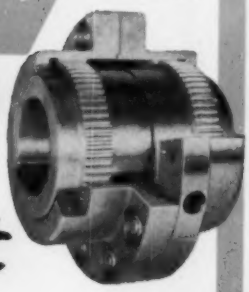
Waldron couplings on a fan drive of jacket water coolers.

by specifying

WALDRON

Gear Couplings

you get



STRENGTH — Hubs and cover sleeves for sizes 1¼A through 7A are machined from tough steel forgings. Hubs are keyed to the shafts. The two one-piece cover sleeves function as a single, rigid unit serving as a floating connecting link between the hubs. High strength of forgings makes possible a very compact coupling with low rotating inertia.

RELIABILITY — There are no flexible parts to bend or break and the coupling is dust, moisture, and oil tight. Patented Walflex seal is positioned where centrifugal force is least. Clearance between teeth in hubs and sleeve is engineered so that an oil wedge always separates them, taking the wear.

SERVICE — Plenty of rough bore couplings, already assembled—on the shelf for *immediate* delivery. Finish bored standard couplings shipped to meet customers' schedules. We are geared up to give you realistic delivery on *any* type of couplings.

▸ Ask for Catalog 57

JOHN WALDRON CORP.

NEW BRUNSWICK, NEW JERSEY

Representatives In Principal Cities

BRANCH
after
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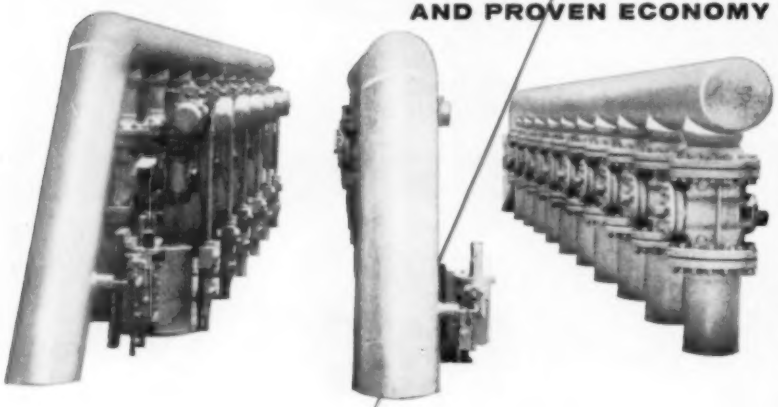
WELDOLETS

FOR ASSURED STRENGTH

AND PROVEN ECONOMY



WELDOLETS

THREDOLETS

SOCKOLETS

Are y o u effecting this economy for your company? Neat and uniform appearance is evident in code constructed weldolet headers in this crude oil pipeline terminal. The money saved is in the bank and does not appear in this picture. If you are not using the weldolet method of cutting piping costs, write today for information.

SOLD THROUGH LEADING DISTRIBUTORS

BONNEY

PENNSYLVANIA DIVISION

BONNEY FORGE & TOOL WORKS

ALLENTOWN, PA. Dept. H

recently opened at Andrews, Tex. C. C. Talbot, formerly based at Harvey, La., has been appointed branch manager at Houma, La. T. G. McBride has been appointed branch manager at Pampa, Tex., replacing D. A. Stuart who has been appointed assistant district manager, Kansas district.

Tex-Tube, Inc. Elects George E. Cullen, Jr. . .

G. E. CULLEN, JR.

as v i c e president and secretary-treasurer. He will headquarter in Houston, according to Charles A. Carter, president.

Cullen was vice president and general manager of a Houston oil-field equipment manufacturing company for 3 years prior to joining Tex-Tube. His experience also includes service with Barron, Wade, Guthrie & Co.

Tex-Tube, headquartered in Houston, is a major manufacturer and distributor of oil-field tubular goods and industrial piping.

A. Roland Regis Named by Coates Field Service, Inc.

Regis will be eastern contact representative for the New England states, Pennsylvania, Virginia, West Virginia, Delaware, Maryland, New Jersey, Indiana, Illinois, Ohio, and Kentucky, as well as the eastern provinces of Canada.

Regis was formerly with the Federal Bureau of Public Roads and has had many years' experience with right-of-way acquisition, planning and estimating, both in this country and Canada.

Kaiser Steel Corp. Expands Napa Plant . .

with a $2,000,000 program for the Kaiser Steel Fabricating Division. According to Ernest L. Ilsley, general manager of the Napa and Fontana operations, the expansion, when it is completed in 1959, will nearly double the Napa, Calif., plant's pipemaking capacity, making it one of the largest plants in the world for fabrication of line pipe for petroleum and gas transmission.

Major facilities under construction include a 50,000-sq.-ft. addition to the pipe-fabrication plant to house additional welding, facing, expanding and testing facilities, new buildings,

The Most Economical Pumping Unit Ever Built

...and the smoothest operating

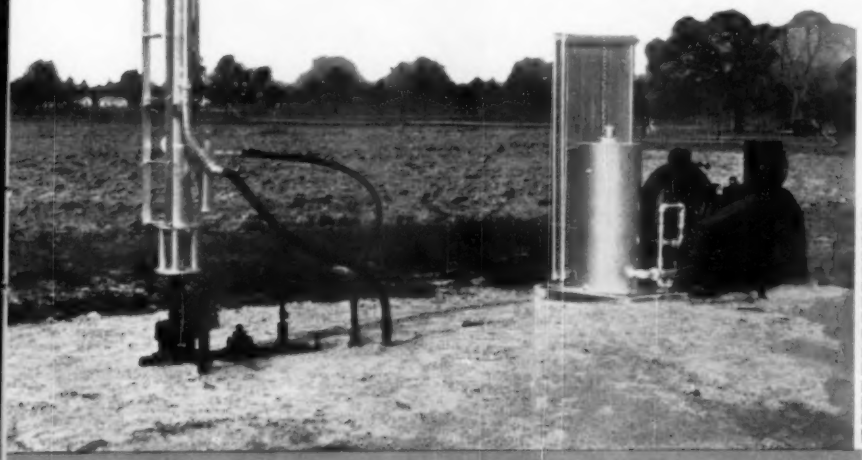
JOHNSTON
Hydraulic
PUMPING UNITS

The low price of Johnston Hydraulic Pumping Units is due to streamlined, simplified design and manufacture, made possible by years of experience in production and hydraulics.

From grass roots to 9000 feet—that's the range of Johnston Hydraulic Pumping Units. They may be powered by electric motor or any type internal combustion engine.

Remember this. Here is a pumping unit that will SAVE YOU MONEY—Cost you Less than any competitive unit. Less for Transportation; Less for Installation; Less for Maintenance; Increase Life of Sucker Rods, Bottom Hole Pump, and in many instances increase production.

3 FT. STROKE **6 FT. STROKE** **9 FT. STROKE** **12 FT. STROKE**



MAIL THIS COUPON FOR SPECIAL PAMPHLET CONTAINING APPLICATION CHART AND MECHANICAL FEATURES OF JOHNSTON HYDRAULIC PUMPS. NO OBLIGATION.

ENGINEERED OIL TOOLS, INC.
P. O. Box 1665 • Houston, Texas
Please mail special pamphlet on Johnston Hydraulic Pumps to:

Company

Person

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DISTRIBUTED THROUGH SELECTED SUPPLY STORES BY

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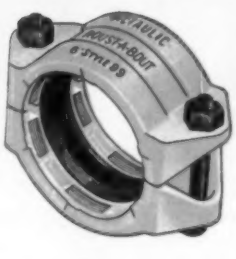
VICTAULIC®

METHOD OF PIPING

VICTAULIC HAS EVERYTHING...

VICTAULIC COUPLINGS
Simple, fast, reliable. *Styles 77, 77-D,* for standard uses with steel or spiral pipe, — *Style 75* for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¾" to 60".

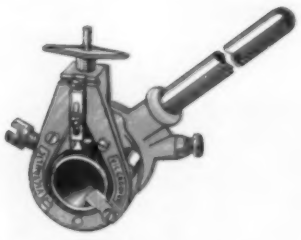


ROUST-A-BOUT COUPLINGS
For plain or beveled end pipe *Style 99.* Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 12".

VICTAULIC SNAP-JOINTS
The new, boltless, speed coupling, *Style 78.* Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

COUPLINGS FOR EVERY PIPING JOB

VICTAULIC FULL-FLOW FITTINGS
Elbows, Tees, Reducers, Laterals, *a complete line*—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¾" to 12".



VIC-GROOVER TOOLS
Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes ¾" to 8".

PLUS FITTINGS AND GROOVING TOOLS

"EASIEST WAY TO MAKE ENDS MEET"

Promptly available from distributor stocks coast to coast.
Write for NEW Victaulic Catalog-Manual No. E-11.

VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.

and more handling and storage areas.

The Napa plant produces electric weld pipe and expanded fusion weld pipe. The new facilities will make it possible for this plant to produce pipe up to 42 in. in diameter.

Kaiser Steel also has a current $194,000,000 expansion program of its Fontana steel mill under way. This expansion is now more than half completed.

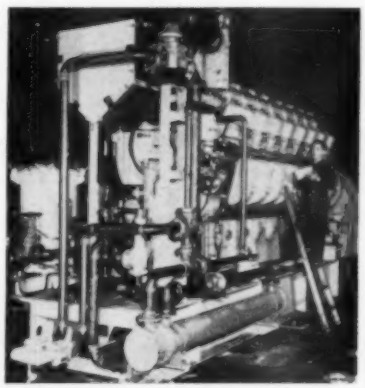
McMillan, Woelfel, and Daniels Named by Cameron

W. L. McMillan has been added to the sales and service force at Gretna, La. Albert E. Woelfel and A. S. Daniels have been added to the engineering staff of Cameron Iron Works, Inc.

McMillan has served the last 2 years with McCullough Tool Co. as an operating engineer. Formerly the chief design and development engineer for Ruska Instrument Corp., Woelfel will work on commercial product research and development projects for Cameron. He was with A-1 Bit & Tool Co. from 1947 to 1955. Daniels has been assigned a special project to make stress studies on new Cameron products.

Alco Products Inspects Indonesia Shipment . .

of one of five diesel engines for pipeline pumping or power generation in crude-oil operations on Sumatra. Three of the engines were equipped with generators to form diesel-electric generating packages for power service.



The diesel generating and pumping units were built for Bechtel Corp., engineer-constructor on Sumatra for Caltex Pacific Oil Co. They will be used in a crude-oil transportation system under construction at Duri, Sumatra.

The engines will operate on raw crude from the wells they service, burning oil that has been centrifuged on the island. The pumping engines produce 2,040 hp. at 1,000 r.p.m., and the generating-set engines develop 1,840 hp. at 900 r.p.m.

Applied Power Opens Dallas Branch

The addition of the Dallas-Fort Worth territory brings to 118 the number of Texas counties served by Applied Power Equipment & Manufacturing Co., exclusive distributors for Allis-Chalmers and Buda division engines and generator sets.

The district manager is Levi A. Hays, associated with Buda products 21 years. He was general service manager for Buda Engine & Equipment Co., Inc. and assistant engine sales manager for Allis-Chalmers' Dallas branch.

D. H. Miller Named Mgr. By Square D Co. . .

for its western division, with headquarters at Los Angeles. According to Gordon Patterson, president, Miller for the last 5 years has been Northwest regional manager at the Seattle, Wash., plant of the western division, which also has production units in San Francisco and Denver in addition to Los Angeles. Miller succeeds Lawrence G. Maechtlen, who recently moved to the company's executive offices as first vice president.

Miller joined Square D as a draftsman in Los Angeles in 1935 and has successively held sales and production positions in the company's West Coast operations.

Vertical Turbine Pump Assn. Elects Officers . .

at the group's fall conference held in Yosemite, Calif. F. E. Dunn, general manager, turbine pump division, Worthington Corp., was elected president for 1958. Harold Miller, general manager of Johnston Pump Division of Youngstown Sheet & Tube Corp., was elected vice president, and B. A. Tucker, former sales manager (retired), Peerless Pump Division, Food Machinery & Chemical Corp., was appointed as manager, to serve in addition to his capacity as secretary-treasurer, a position he has held for the past year.

Elected as new members of the executive committee were G. F. Twist, vice president, Peerless Pump Divi-

STOCKS • BONDS

COMMODITIES

★ RESEARCH ORGANIZATION: Specialized and general information and statistics by telephone or mail.

★ BONDS AND UNLISTED SECURITIES: Extensive facilities for reaching large and small markets.

★ COMMODITIES: Long experience in handling grain, cotton and other commodities.

★ SUPERVISED INVESTMENTS: Portfolio analysis and continuing supervision.

★ BLOCKS OF SECURITIES: We specialize in handling large blocks of securities.

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Members N. Y. Stock Exchange
New York Curb Exchange
Chicago Board of Trade
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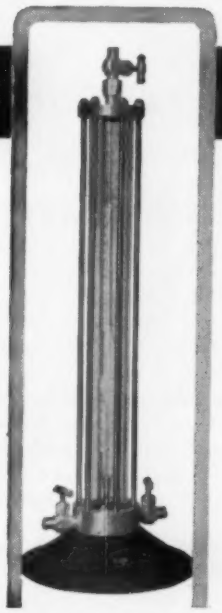
TULSA, OKLAHOMA
36 Offices Coast to Coast

PRESSURE HYDROMETER JAR



For obtaining specific gravity of liquefied petroleum gases, such as propane and butane, which under normal atmospheric pressure would evaporate into a gaseous form. Jar withstands operating pressures of 200 psi at normal temperatures. Equipment consist of clear lucite tube, aluminum end caps held by tie-rods and a conical base. Three needle valves allow entry of the sample and adjustment of the liquid level.

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SANTA CLARA LOS ANGELES TORONTO MONTREAL VANCOUVER OTTAWA

New 350-mile "Oklahoma Extension"

taps new field...

A. O. Smith furnished 262 miles of the 26-inch pipe. Photo above shows some of the difficult conditions encountered in putting in the line.

Natural Gas Pipeline Company of America puts line into service in late November of '57

This new line (mainly 26-inch pipe) allows Natural Gas Pipeline to augment existing supplies from their fields in the Texas Panhandle. With the new line, they'll be able to increase reserves up to 127,000,000 cubic feet per day from new fields in Jack and Wise Counties, Texas.

The Oklahoma Extension will tie in with the Company's mainline at a point near Fritch, northeast of Amarillo. It represents better than a 10% addition to their present pipeline network that includes 1400 miles for affiliate Texas-Illinois Natural Gas Pipeline Company and 1700 miles for Natural Gas Pipeline Company.

262 miles — of 26-inch pipe was furnished by A. O. Smith. In fact Natural Gas Pipeline Company and A. O. Smith have enjoyed a long and mutually satisfactory association. Over 1000 miles of the 30-inch pipe for the previously mentioned Texas-Illinois line was also supplied by A. O. Smith.

For almost 30 years . . . A. O. Smith line pipe has always been manufactured to a high standard of quality . . . precisely controlled at every step of production. That's why A. O. Smith pipe, made and installed in 1928, is still in operation. That's why so much A. O. Smith pipe is in nearly every important high-pressure line.

Through research A.O. Smith *. . . a better way*

A.O.Smith

CORPORATION

TUBULAR PRODUCTS DIVISION

Milwaukee 1, Wisconsin

Chicago 4 • Dallas 35 • Houston 2 • Los Angeles 17 • Midland 5, Texas • New Orleans 12 • New York 17 • Tulsa 3 • A. O. Smith International S. A., Milwaukee 1, Wisconsin, U. S. A.

expands reserves

Construction of the Oklahoma Extension, a four-month project, included erection of suspension bridges to carry the pipe over severely eroded terrain and a number of soil-conserving, erosion-control dams.

The 350-mile line extends from newly tapped fields in Jack and Wise Counties in Texas and swings north into Oklahoma and then back into the Panhandle to tie in with the Company's existing mainline near Fritch, Texas.

NOW TRANSISTORIZED

power supply · speaker · microphone

MOTOROLA T-POWER 2-WAY RADIO

Improved Performance with Lower Operating Cost

Already famous for the lowest maintenance and operating costs in the mobile 2-way radio field, Motorola radio is an even better investment now—with T-POWER. The vibrator is gone! . . . replaced by rugged, long life transistors. Reduced "down-time", lower maintenance, and greatly improved performance *all* result from this new development. The transistorized POWER VOICE Speaker is 10 times more powerful than conventional speakers . . . talks *through* noise and can be heard hundreds of feet away from the vehicle. The transistorized Dynamic Microphone gives unprecedented voice clarity and greater communications range.

New Mounting Flexibility with Plug-In Control Head . . . Same Basic Unit can be Used for Front or Trunk Mounting

With the T-POWER radio you are no longer restricted to one type of mounting. Install the complete radio, with drawer unit and plug-in control head, for under-dash mounting. For rear mounting, the same basic drawer unit can be installed in the trunk and connected by cable to a dash-mounted control head. And—the same basic drawer unit can be interchanged with the equivalent Motorola Twin-V trunk mount models operated from a 12-volt negative ground source.

Get all the facts. Write now for literature with complete information.

MOTOROLA T POWER TRANSISTOR POWER 2-WAY RADIO

Transistorized Power Supply for receiver and 25-watt transmitter.

MOTOROLA Communications & Electronics, Inc. · 4501 Augusta Blvd., Chicago 51, Illinois · A Subsidiary of Motorola, Inc.

sion; Harry E. Carloss, vice president, The Deming Co.; and J. P. Adams, vice president, Byron Jackson Division, Borg Warner Corp. Dan R. Rankin, chief engineer, Peerless Pump, was elected chairman of the association's technical committee.

Export Appointments Announced by HOMCO . .

C. J. ERWIN

with naming of C. J. Erwin as export manager and H. D. (Bob) Robinson as assistant export manager. According to D. B. Allison, director of exports for Houston Oil Field Material Co., Inc., both men will be located in New York City.

Erwin, with Homco since 1944, leaves the position of division manager of services for Louisiana and Mississippi, where he was stationed in New Orleans. Robinson has been with Homco since 1946, previously as resident manager at Tulsa.

Philips Electronics, Inc. Adds Service Manpower . .

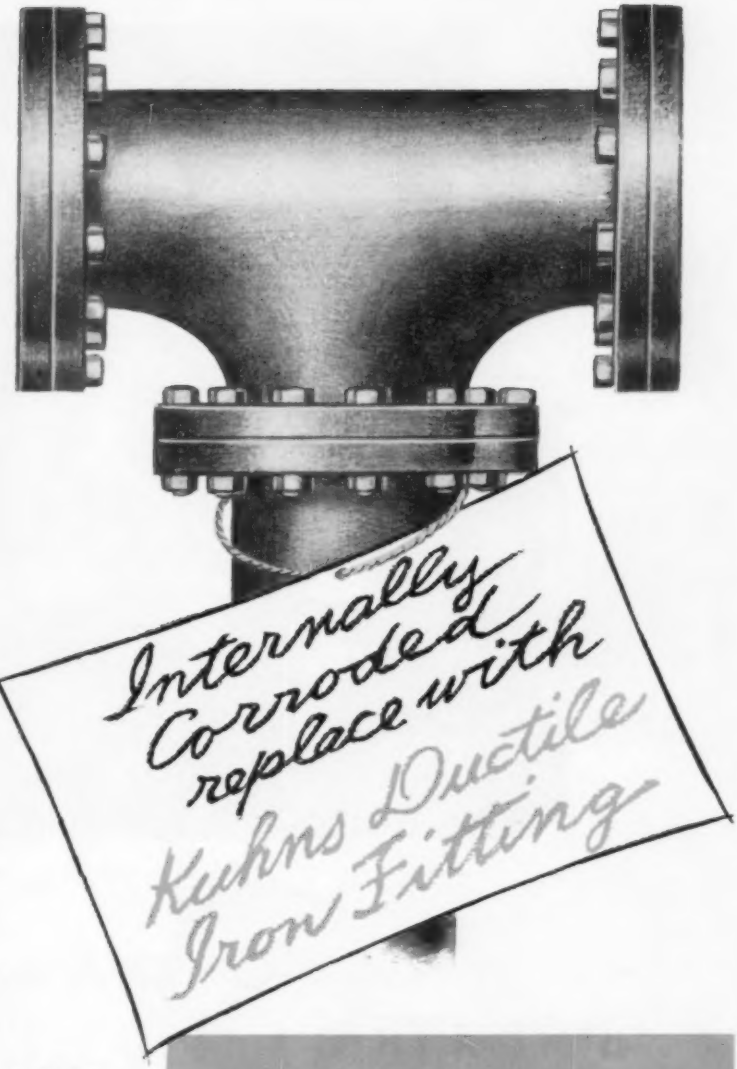
in its instruments division, Mount Vernon, N. Y. Thomas Murphy, Clay Littleton, and George Walsh are currently being trained as field service engineers and will be assigned to field offices soon.

Ronald Robbins has been appointed administrative assistant to Thomas Turnbull, service manager. James Malloy assists Henry Court, sales administration manager. with orders and quotations.

Fred Dyroff has been transferred to the service department where he now serves as service foreman in charge of factory repairs. He also handles application studies on industrial X-ray equipment together with X-ray diffraction field service in the New York area.

Du Pont Finishes Division Sets Up New Unit . .

to be known as the industrial maintenance sales section of the trade sales division. With headquarters in Wilmington, Del., the new service group will offer specialized assistance in the petroleum and steel industries. Four district managers will be located in Philadelphia, Atlanta, Chicago and Kansas City. West Coast district supervision will remain with regional



"K" flanges and flanged fittings all sizes through 12".

"K" screwed fittings ¼" through 12".

• OVERCOME CORROSION
• PROMOTE SAFETY
• REDUCE MAINTENANCE

These are just a few of the reasons why more and more companies specify Kuhns ductile iron fittings, pressure rated by Underwriters' Laboratories, Inc. If you're handling corrosive or volatile fluids, send for complete details today.

"K" fittings available nationally through better wholesalers

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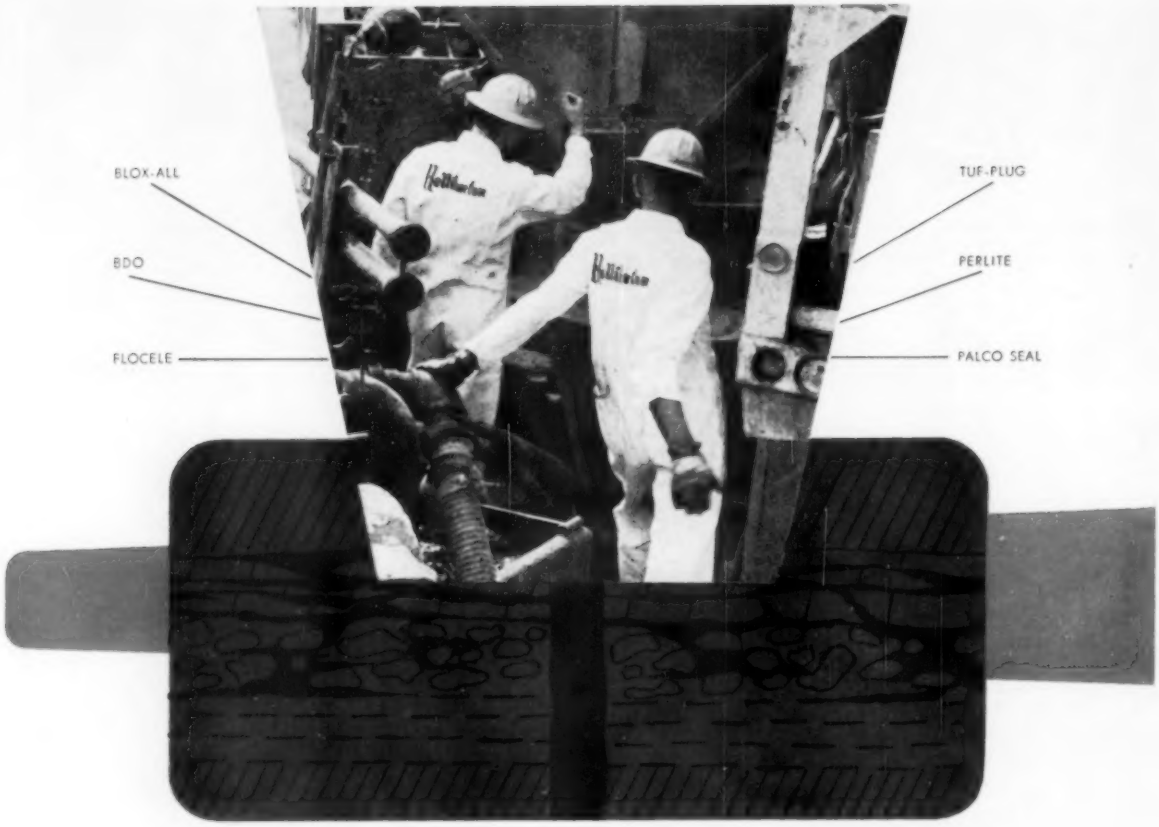
1887 • 70 years of continuous progress • 1957



The RIGHT REMEDY for every type of
LOST CIRCULATION EMERGENCY

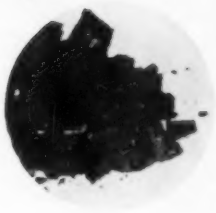
When drilling through highly permeable formations, cavities, fissures or vugs, lost circulation is a common difficulty. If lost circulation is not remedied, it may jeopardize the success of the drilling operation. In any case, serious loss of rig time and greatly increased cost can result.

Each geographic region . . . each type of thieving zone . . . each well condition presents different remedial problems.

By plugging, blocking, squeezing and other techniques . . . in combination with the proper tools and the right materials . . . Halliburton specialists help regain lost circulation in each individual emergency case.

At the first sign of lost circulation . . . consult Halliburton immediately. Your nearby Halliburton Representative will help save "profit-life" by rushing the proper remedies to the site.

HALLIBURTON
OIL WELL CEMENTING COMPANY
DUNCAN, OKLAHOMA



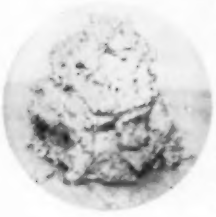
BLOX-ALL . .

a chemical solution for treating difficult lost circulation problems during drilling. Blox-All solution thickens in drill pipe into a soft gel stage, is then extruded into lost circulation zone. Mixed at the site and pumped as a liquid into the well through the drill pipe, it sets to form a stiff, rubbery mass.

TUF-PLUG . . .

supplies high strength, angular granules in cement slurries to quickly bridge wide fractures more effectively than most fibrous materials. Tuf-Plug is effective alone or as a good companion material to use in conjunction with other flake or fibrous lost circulation materials to seal extremely stubborn zones. The high mechanical strength of Tuf-Plug will support high columns of heavy cement slurries.

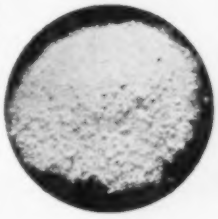
HALLIBURTON PRODUCTS AND MATERIALS
quickly help cure lost circulation problems



BDO

(BENTONITE-DIESEL OIL..."GUNK SQUEEZE")...

penetrates lost circulation area as putty-like material. BDO is a thin slurry of Bentonite and Diesel Oil: Bentonite combines with water to swell and form a high-strength gel, Diesel Oil acts as carrier. BDO slurry is mixed with standard cementing equipment and hopper. Pumped down drill pipe at same time drilling mud is pumped down annulus. Slurry mixes and thickens by hydration with drilling mud to a putty-like material . . . entering zone of lost circulation for desired shut-off.



PERLITE . . .

is a light weight mineral used in granular form as an additive to cement. Expanded perlites are used both as bridging agents and as fluid column weight reducers.

HALLIBURTON'S FLOCELE . . .

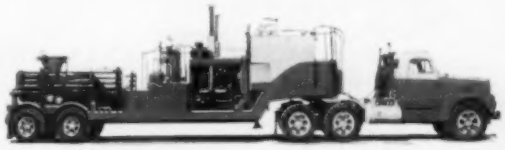
when added to cement slurries, effectively bridges and seals most fissures and other thief zones. It prevents or lessens loss into permeable formations during casing cementing. Flocele is chemically inert cellulose film flake which does not affect the pumping or setting properties of cements. Economical; usually 1% or less of Flocele is sufficient.

PALCO SEAL . . .

composed of redwood fibers, offers several advantages as drilling mud additive in lost circulation problems: Economical, both in price and volume . . . Free from decay . . . Free from added chemicals which affect viscosity of drilling mud . . . Expansible . . . Uniform in bale or sack size, easy to stack or handle.

CEMENTING SERVICES

284 SERVICE CENTERS—JUST MINUTES AWAY FROM YOUR WELL



trade sales and industrial managers in San Francisco.

Frank Smith, formerly regional industrial manager in Kansas City, has been appointed to head the new section. Smith has been with Du Pont finishes division for 29 years in laboratory and field assignments.

Jack Graham will be district manager in Philadelphia; Herb Norton is appointed to Atlanta; Tom Robertshaw receives the Chicago post; Leo Hoellen goes to Kansas City. Smith's staff also includes Jack Rode, product manager, and Bob Bradley, maintenance specialist.

General Industrial Supply Expands Activities . .

in the Oklahoma and Kansas areas. Ralph S. Clapp has been appointed field engineer headquartered in Tulsa, according to J. D. Craig, president. Clapp, together with J. R. Lawrence, sales representative, will be responsible for sales and engineering in northern Oklahoma and southern Kansas.

Before joining the corporation, Clapp was with Nelson Electric Co. in Tulsa as sales service manager.

General Industrial Supply specializes in oil-field electrical motor and control equipment and is distributor in the Southwest for Robbins & Myers, Inc. and Cutler-Hammer, Inc. Main offices and warehouses are at Fort Worth, with available stocks and sales offices at Midland, Houston, Borger and Dallas.

Sales Reorganization Made By Flori Pipe Co. . .

and another subsidiary of Sparton Corp., Houston Pipe & Steel, Inc. This coast-to-coast sales team offers extra service on the spot for piping fabrication service and information. Serving as district sales managers are William E. Keim, headquartered in New York City; Herman C. Heink, St. Louis, Mo.; D. W. Jacobus, Tulsa; Kenneth E. Martin, Los Angeles; and J. B. Spurlock, Houston.

American Cyanamid Co. Appoints J. F. Allen . .

manager of the refinery chemicals department of its industrial chemicals division, according to George W. Russell, division manager.

The company's refinery chemicals department produces catalysts, oil additives and other chemical specialties for the petroleum industry.

Allen, formerly assistant manager of the department, joined Cyanamid in 1950 and has served in a variety of sales and technical posts in the industrial chemicals division.

J. E. Zeller Named to New Armstrong Cork Co. Post

The position of general superintendent of construction in insulation contract operations, according to A. E. Pearce, general sales manager of the insulation division, is a new position established to concentrate on job organization techniques and strengthen supervision on large contract jobs.

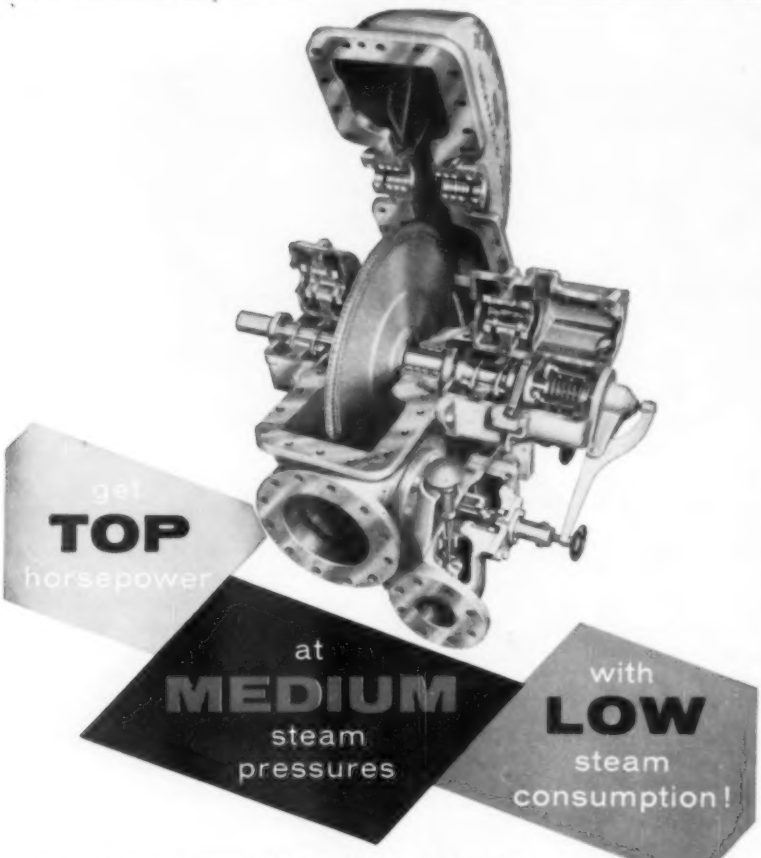
Zeller will be replaced as an assistant in contract operations by Robert H. Lawrence, who has served in the Baltimore district office for the past 10 years.

Claude E. Foster, of Armstrong's Dallas district office, has been transferred to Houston as branch manager.

Alex W. McCoy Associates, Inc., Expands Staff . .

in Tulsa and Calgary, Alta., Canada. McCoy also has offices in Denver and Casper, Wyo.

Joining the Tulsa office, according



Choose from the improved DH Line of Dean Hill horizontal turbines which give you up to twice the power of earlier models while maintaining the same economy of operation.

The major change contributing to this tremendous power increase is the addition of steam nozzles to all models. On types now built with two nozzles—DH-10, DH-15, DH-20, DH-25—this change has meant *a 100% increase in the maximum horsepower of each unit!* On new three-nozzle models—DH-30, DH-35, DH-40, DH-45—the rated increase in maximum horsepower is 50%!

Why not get the complete power picture of Dean Hill's improved DH Line of horizontal turbines? Write today for Turbine Catalog, No. 500.

DEAN DH HILL PUMP COMPANY
Pump and Turbine Engineers Since 1893
Indianapolis 7, Indiana

OFFICES IN PRINCIPAL CITIES

TWO NEW TOWER DISTRIBUTORS

"WEIR-FLOW"
for medium-to-high liquid rates

"MULTI-LEVEL"
for low-to-medium liquid rates

The development of newer tower packings (such as Intalox Saddles and Metal Pall Rings) brought into sharp relief the need for better liquid distributors to permit full utilization of the better performance characteristics of these packings.

U. S. Stoneware developed, pilot-plant and field-tested, a number of distributors. Two, in particular, showed far superior operating characteristics, and are now offered as standard items in our line.

The "WEIR-FLOW" Distributor: Cylindrical risers with "V" notches are used as downcomers for the liquid, permitting greater flow as the head increases. Provides uniform liquid distribution over a wide range of medium to high liquid rates. Made in chemical stoneware and chemical porcelain in a range of sizes to fit towers up to 8 feet in diameter; also in carbon steel or stainless steel for towers as small as 6″ i.d., and in larger diameters to fit customer's specifications.

The "MULTI-LEVEL" Distributor: Essentially a tray with a perforated bottom, but the perforations drain at three different levels. Provides uniform liquid distribution over a wide range of low to medium liquid rates. Made in chemical stoneware and in chemical porcelain for towers from 24″ to 60″ in diameter.

SEE THEM AT THE CHEM SHOW, NEW YORK COLISEUM, DECEMBER 2-6, BOOTH 111

102-F

New Booklet on SUPPORT PLATES and DISTRIBUTORS

New 24 page booklet just off the press describes our complete line of support plates and distributors. Write for it today. Ask for Bulletin TA-30.

U. S. STONEWARE
AKRON 9, OHIO

to Alex W. McCoy, president, are F. M. (Mac) Stewart, Myron L. Vance and O. Lewis Smith. New men for the Calgary office are Elmer L. Herbaly and William Slemko.

Stewart was formerly staff engineer and specialist in reservoir engineering for Pan American Petroleum Corp. Vance previously was a geologist for Sunray Mid-Continent Oil Co. Lewis was with Sun Oil Co. as division petroleum engineer.

Herbaly, before joining McCoy, was zone geologist for Gulf Oil Corp. in Oklahoma City. Slemko was with British American Oil Co. as a geologist.

Dewey Supply Co. Elects David A. Bartlett . .

president at a special meeting of the board of directors, according to Dewey F. Bartlett, chairman of the board. Bartlett succeeds Malcolm B. Roach.

Other new officers elected were C. H. McKnight, secretary-treasurer; Wilbur J. Holleman, Jr., assistant secretary-assistant treasurer; Thearon J. Rhodes, assistant secretary-assistant treasurer. Holleman was also elected a director to fill the vacancy left by Roach.

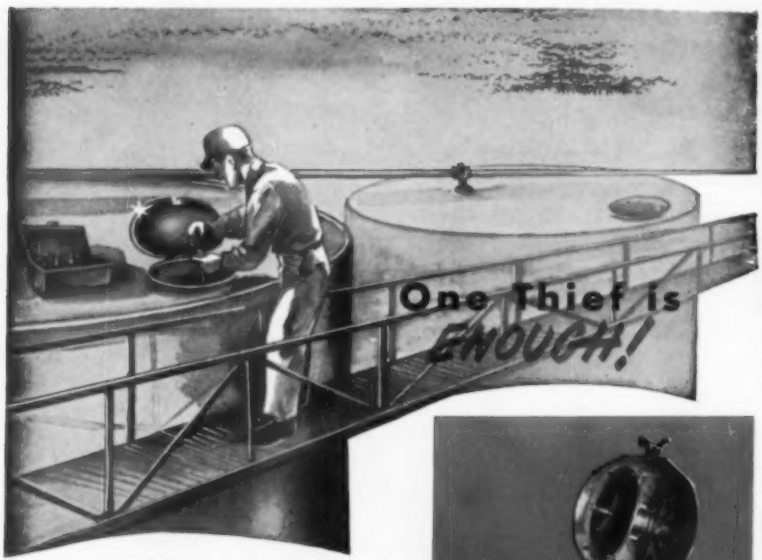
Wilbur J. Holleman, Sr. will remain a vice president of the firm, and Katherine H. Brown will continue as assistant secretary-assistant treasurer.

The new president is a partner in Keener Oil Co. and president of Atlas Gasoline Corp.

James H. McGill to Represent Republic . .

in the states of Texas, Oklahoma, Louisiana, Arkansas and New Mexico. He will make his headquarters in Dallas, Tex.

Republic Manufacturing Co., Cleveland, is a manufacturer of industrial valves.



Don't let vapor losses (or other thieves) steal you blind.

1. Corrosion of tanks. Reduced when correct pressure setting is maintained on all tanks in storage battery, and oxygen is excluded.
2. Gravity drop (premium of 2c per barrel) can be stopped. Many users of vapor control system have reported gravity increases after installation.
3. Volume losses (2½% per degree gravity drop). Very substantial savings have been reported.
4. Lifting costs. These costs can be cut, because with the gravity and volume losses stopped, every barrel produced is saleable.

The elimination of any one of these thieves will more than pay for the installation of an Enardo vapor control system.

The Enardo 770 "By-Pass" thief hatch valve shuts off from the vent line for vapor control. When the hatch is open the "By-Pass" controls the opening into the vent line, sealing off the rest of the tanks in the battery. This automatically holds the correct pressure settings and excludes oxygen. Holding the pressure in all tanks prevents large gravity and volume losses during normal working conditions. The 770 Series hatches feature "bottle-tight" seals and De-icer action gaskets.

Call, write or wire Enardo for additional information.

770 VAPO-GARD THIEF HATCH VALVE

770-BP VAPO-GARD THIEF HATCH VALVE

ENARDO manufacturing company

BOX 1647 TULSA, OKLA

National Tank Co., Ltd. Switches Smith, Godwin

T. E. SMITH

Tracy E. Smith replaces Jack A. Godwin as vice president and general manager. Godwin has returned to National Tank Co.'s headquarters in Tulsa. Smith joined National in 1940 and has served as district engineer, branch manager, division engineer and in 1952 was returned to the Tulsa office as chief sales engineer.

Godwin went to work for National in 1935. In 1948 he was transferred to Canada to organize National Tank Co., Ltd., a wholly owned subsidiary. He was manager of the Canadian division until his return to the Tulsa office. He is now head of inventory control for the 50 National offices and branches.

Jimmie H. Goss Named by National Supply Co. . .

as division sales representative in Toledo for its eastern division. Goss succeeds David E. Bayer, now assistant district manager at Charleston, W. Va.

Goss joined the company in 1951, serving at the Salem and McLeansboro, Ill., stores. He was transferred to Olney, Ill., in 1952 and has been district sales representative there since 1955.

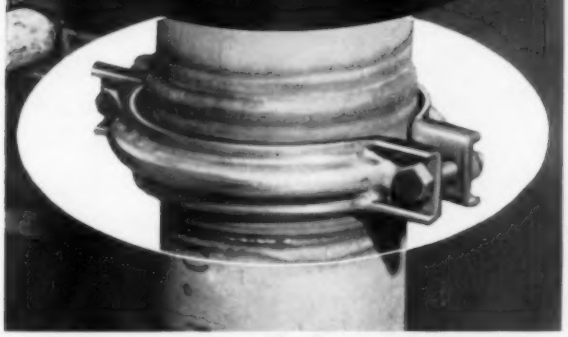
Grant Oil Tool Co. Makes W. E. Childers Agent . .

in Maracaibo and Barcelona, Venezuela. He will be field sales representative for Grant and its subsidiary, The MacClatchie Manufacturing Co.

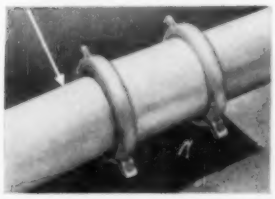
MARMAN Servicemaster

V-Band Tube Joint

Installs Easily... Allows Fast Servicing



Use the Marman Servicemaster* V-Band Tube Joint to connect tubing without bolted flanges. Ideal for all oil, gas, chemical, fuel, steam and water systems needing frequent disconnection. Available in corrosion resistant or mild steel for O.D. tube sizes from 1½" to 4½".



Flexmaster* Pipe Coupling joins pipe without cutting or threading. Dampens vibration and shock, takes misalignment. Sizes for 2½" and 3" pipe.

Universal Flagmaster* insures quick, positive identification of pipe lines and valve stations. Fits 1" to 16⅛" O.D. pipe sizes.

All metal CONOSEAL* tubing joint maintains a perfect seal over a wide range of pressures and temperatures; withstands slight linear deflections, eliminates bolted flanges and provides low envelope clearance, plus easy servicing. Available in a wide range of sizes.

MARMAN DIVISION
Aeroquip Corporation

*Aeroquip Trademarks

INDUSTRIAL SALES DIVISION
11214 Exposition Blvd.
Los Angeles, California

Please send full information on Marman tube and pipe joints for oil field applications.

Name_____

Title_____

Company_____

City_____ Zone____ State_____

The stoutest pipe vise .... with built-in folding legs and tray

RIDGID

Tristand Pipe Vise

RIDGID Tristand Pipe Vise, yoke model.

Chain model also available.

Extra easy to fold up, carry and set up... Extra strong, extra rigid in use

Most service and durability for your money! Integral legs and tray mean quick easy fold-up for carrying and set-up for work—provide solid stance, greater strength.

Vise base is roomy, has ceiling brace screw, pipe benders, slots for tools. Special LonGrip jaws grip tight without chewing up pipe. Save work—see it, try it, buy it at your Supply House.

The Ridge Tool Company, Elyria, Ohio, U.S.A.

RIDGID
Work-Saver Pipe Tools

One of Many Reasons Why...

Chain Drive is Superior to Gear Drive in Mud Pumps!

When Gears run together under load as in a mud pump drive, a *sliding action takes place between the teeth that might be called a "scouring action."* Under heavy load this tends to rub small flakes of metal off the teeth, particularly if there is even the slightest bit of sand or grit in the lubricant. When these metal flakes get in the oil they are carried back again into the gear teeth where they intensify the wearing process, until it is not long before the gears are completely worn out. And in some pumps this same oil is used to lubricate the bearings, and of course either sand or metal flakes are highly destructive to either plain or anti-friction bearings.

No Sliding Action

In the Wilson Chain Drive Mud Pump no sliding action, *only a rolling action takes place between the sprockets and the chain.*

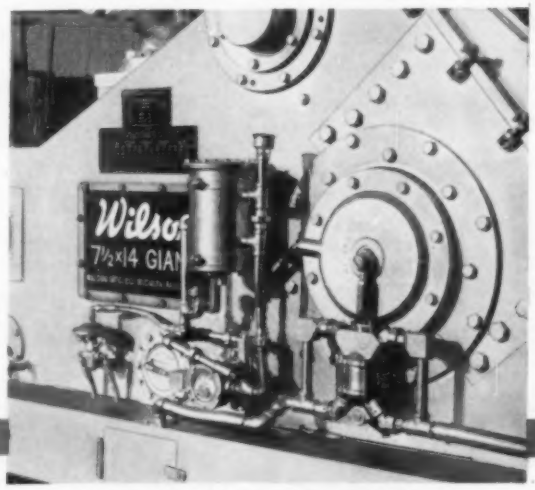
While it is highly desirable to have the oil as free from sand as possible, a small amount of sand is not nearly as destructive to a chain drive as it is to a gear drive. This is *one of the reasons why Wilson uses a chain drive instead of gears.*

Wilson Oil Filtering System

In the Wilson Pump the oil is first passed through a strainer, then it goes through a filter where even fine particles of sand or other foreign matter are removed before the oil is forced into the bearings, etc. Thus *all bearings and wearing parts are pressure lubricated with clean filtered oil, and should have a long trouble free life.*

Trouble Free–Efficient

Wilson Engineers have gone all-out to give the industry a trouble-free pump that will mean longer and more efficient service with an absolute minimum of maintenance. The Wilson Chain Drive Mud Pump offers the operator real pump economy with more NEW and ADVANCED ENGINEERED features than any other pump on the market. Investigate the Wilson now and see for yourself!



Piston rod lubricating pump. Power end lubricating oil pump and filter.

BE MODERN — BUY WILSON

FOR COMPLETE INFORMATION ON
WILSON GIANT "CHAIN DRIVE" MUD PUMP
CALL OR WRITE
WILSON MANUFACTURING CO., Inc.
WICHITA FALLS, TEXAS, U. S. A.
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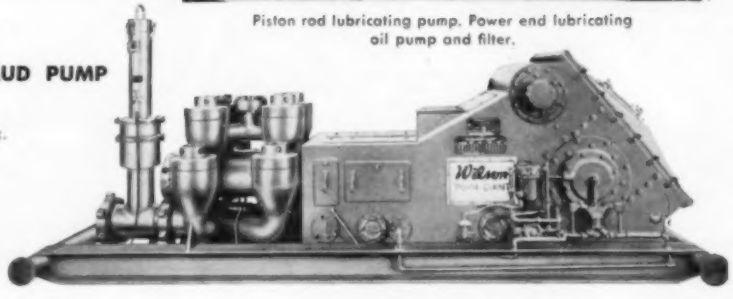


After being with Gulf Oil Corp. 20 years, Childers served in the Houston and Compton branches of Grant.

Marsh Instrument Co. Names Don L. Warner . .

sales representative for its Philadelphia area. He will serve eastern Pennsylvania, New Jersey, District of Columbia, Maryland and Delaware. The new Marsh sales office in Philadelphia will also be under his direction.

Warner has been with the Marsh sales staff 8 years.

LeBus Sets Up Wire Line Spooling in Trinidad . .

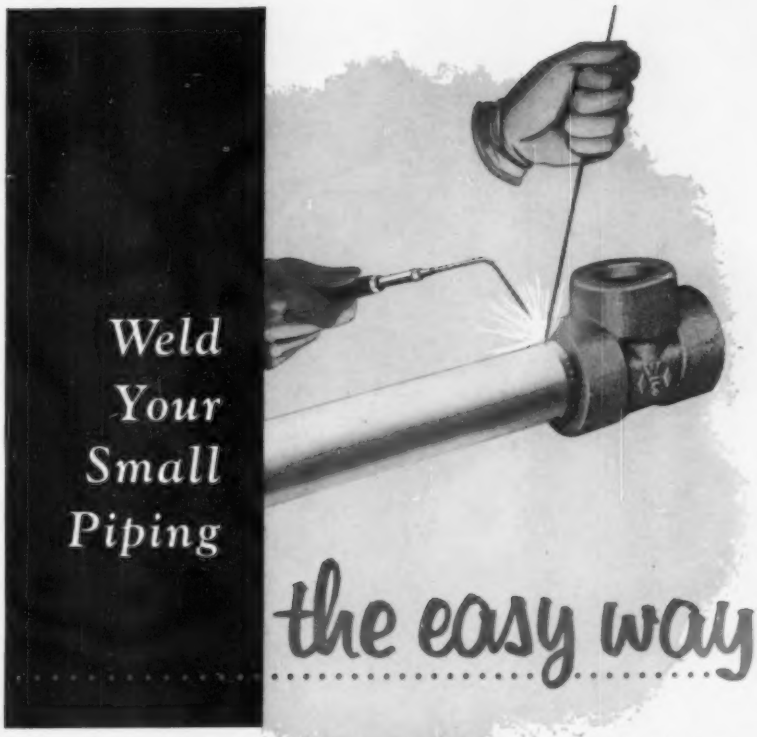
by appointment of Masons & Co., Ltd., Port of Spain, B.W.I., as its exclusive representative in Trinidad. John Rooks, representing Masons, is shown looking over the LeBus International Engineers' knuckle joint, telescope drill joint folder, and machine grooved split core.

Sales Assignments Made by Mission Manufacturing Co.

Francis Hebert has been appointed special sales representative, valve division, for the South Louisiana district with headquarters in Lafayette, La., according to T. R. Fullinwider, domestic sales manager. Formerly, Hebert was field sales representative in the Southwest Texas district with offices in Corpus Christi. Jason Curtis replaces Hebert in Corpus Christi as field sales representative.

Named special sales representative in the valve division for the West Texas-New Mexico district is E. D. (Dean) Hallum. His headquarters are in Midland-Odessa. He was formerly field sales representative in the same district, officing in Odessa.

Replacing Hallum as field sales representative in the Odessa territory is R. E. (Jack) Hardy, formerly field



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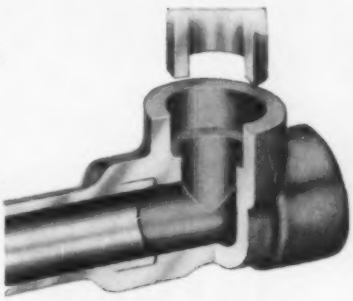

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sales representative in Andrews, Tex. Hardy has been replaced in Andrews by Joe Weaver. Robert L. Rooth has been named field sales representative for the Ark-La-Tex district with headquarters in Shreveport.

Stauffer Chemical Co. Moves Houston Office . .

of the Consolidated Chemical Industries Division. The division has moved from the Esperson Building to larger quarters on Fannin Street.

Rogers Geophysical Co. Establishes Affiliate . .

in London. Managing director of Rogers Geophysical Co., Ltd. is William C. Potter, and geophysical supervisor for the new firm is Russell H. Talty. Sam Rogers is president.

The English affiliate will assist in planning and coordinating overseas geophysical prospecting assignments.

ElectroData Names Airhart To Engineering Post . .

in the San Francisco district. Robert V. Airhart is field engineering supervisor for this division of Burroughs Corp.

According to J. F. Kalbach, field engineering manager, Airhart is responsible for installation and servicing of ElectroData equipment in the San Francisco area. He joined the division in 1955.

Davey Compressor Co. Names C. E. Flora . .

manager of industrial sales. According to J. T. Myers, general manager, Flora will be in charge of all relations with the company's industrial distributors.

Prior to joining Davey, Flora was compressor division manager, Binks Manufacturing Co., and general sales manager, Compressor Engineering Co.

LeTourneau-Type Drilling Rig Is Christened . .

at New Orleans. Barnwell Offshore, Inc.'s "Mister Cap" is a fully diesel electric self-contained LeTourneau-type drilling platform.

Present at christening ceremonies were R. S. Barnwell, Sr., chairman of the board, R. S. Barnwell, Jr., president, Frank H. Harrell, executive vice president, Morton H. Kinzler, vice president, all of Barnwell Offshore, Inc., and R. L. LeTourneau.

Cable Engineering Adds Nathan M. Avery to Staff

He was formerly with The Texas Co. as a petroleum engineer on the Gulf Coast. Cable Engineering specializes in secondary recovery, reservoir engineering, and related services.

Texas Instruments, Inc. Transfers R. G. Hoch . .

to the semiconductor-components division marketing department as materials manager and new products manager. According to Z. W. Pique, division marketing manager, Hoch will manage and supervise marketing activities for the commercial sale of TI's semiconductor grade silicon and related materials. He joins the division after 2½ years with TI's apparatus division where he was manager of service engineering.

Before joining Texas Instruments, Hoch spent 14 years in the engineering field with Minneapolis-Honeywell Regulator Co. where his last position was that of regional manager.

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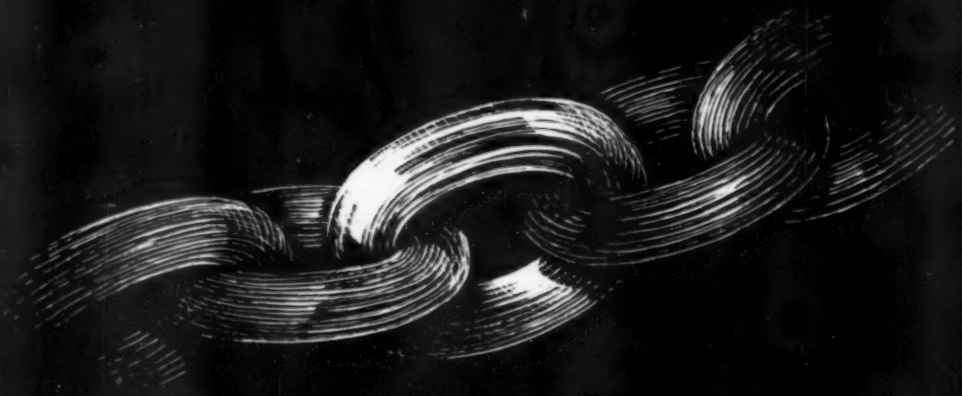
found: the missing link in down-hole correlation . . .



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During the past several months, Core Lab's personnel in the Permian Basin have been performing a very unusual service.

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Currently, many operators in the area are coordinating this "missing link" with visual inspection of the core and down-hole gamma ray logs (from the same well or off-set tests) to pinpoint selective perforating, to accurately orient themselves within a productive section, and to precisely reconstruct the original position of lost core.

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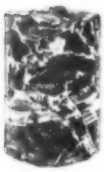

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THIS METAL sculpture hangs in Ohio Oil Co.'s new research center near Littleton, Colo. It depicts the mountain-making forces that shaped the Rocky Mountains, the layering of rock, and the suspension of minerals within them. (From "The Beacon," employe magazine of Ohio Oil Co.)

An Artist Sculpts A Geologic Symbol

By Frank J. Gardner
Exploration Editor

WHAT DO YOU SEE in the photograph shown here? Is it a cubistic plowshare? A mechanized boomerang? Or the fender fin on a 1958 automobile? Does it convey to you any kind of feeling of the earth or air at all?

Ask your geologist. And if he says "Yes, it conveys to me a feeling of the earth, of the mountains, and of tectonic force," then give that man a raise. For here is a metal abstraction, created for the sole purpose of picturing the forces inherent in mountain-building and earth deformation. It's an aluminum expression of tectonics—a geological mural.

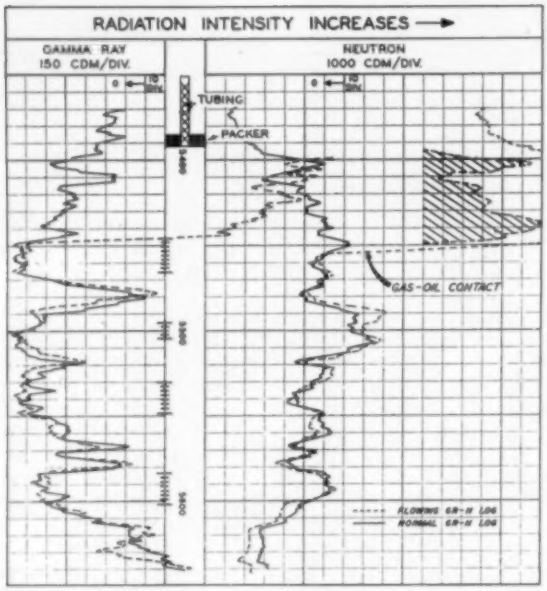
An abstraction . . . It hangs in the lobby of Ohio Oil Co.'s new research center near Littleton, Colo. From its commanding position on the main wall, it faces a large picture window; and from this window, Ohio's visitors have a magnificent view of the Rocky Mountains. What painting, mural, or tapestry could ever compete with this, the real thing? Only something entirely different in design and approach that could still capture the feeling, the shapes, textures, and colors of the mountains would do. The architect, David W. Englehorn, called in an artist, John Paul Miller, of Cleveland; the artist got the idea at once and called in an expert ironworker; and soon this first geological abstraction was on view.

A colorful cluster of aluminum, copper, brass, and bronze in various sizes and shapes, the mural catches the feeling of upheaval and vertical throw, of sideward motion and thrust; the layering of rock and the suspension of minerals are depicted by smaller bits of bronze and brass between the larger free-form molds of motion. These are the impressions the artist was trying to get across.

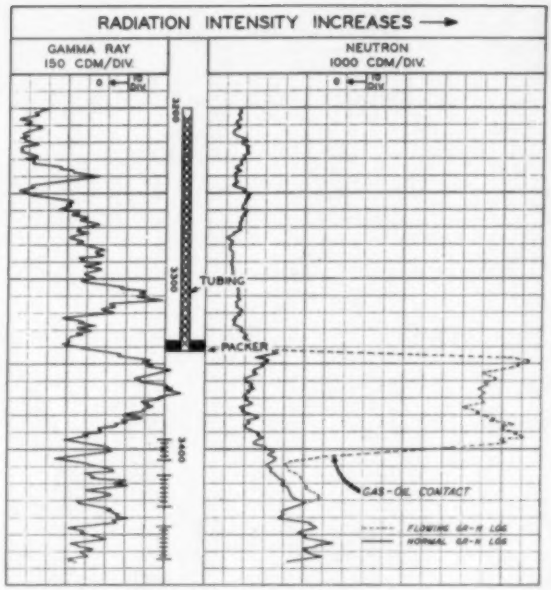
Has a practical side . . . But there's a practical side to this piece of art, too. For it is the ability to visualize three-dimensional form that has enabled the geologist to unravel the history of the earth. Ohio has simply placed it on a wall for all to see. The talent to look at a flat map and construct in the mind's eye a clear picture of a solid object is one of the things that sets the rockhound apart. Add to this a memory for design, and a capacity to retain a mental picture of outline, form, proportion, and geometric pattern, and you have the typical oil finder. He is constantly reconstructing the past while observing only the present. A layman can look at a mountain; the geologist tears it apart and rebuilds it. To most people, the Grand Canyon is an awesome ditch and no place to be caught after dark; but to the geologist, it's a textbook of history, peopled with extinct creatures and written by the ancient seas.

Without this imagination, this ability to reconstruct the past, the oil industry would have had a hard time of it indeed these past few years. And as oil becomes ever harder to find in quantity, this applied imagination will assume even greater importance. Our college geology departments are well aware of this, and many a curriculum today is studded with courses that demand the visual mind. Oil companies, too, are aware of it. As one major Canadian operator puts it, ". . . Purely mechanical contouring without the benefit of geological thinking can lead to many erroneous interpretations and much needless expense . . . New data is useless without trained minds to convert it." This particular company prides itself on developing not geologists or geophysicists, but "explorationists," an imaginative, thinking combination of the two. An explorationist can take simple marks on paper and give them life by interpreting them in terms of texture, form, and shape.

Perhaps you see nothing in this photograph. Maybe you see a lot. If you see nothing, admit the certain beauty of the thing. If you see a lot, concede the artist earned his fee.



LOGGING TOOL is weighted with sinker bars to get on bottom while the well is actually flowing. Here it is easy to spot the gas-oil contact. Fig. 1.



USUALLY the wellhead is rigged with a 30-ft. joint of tubing and a bypass lubricator head prior to logging. Little mechanical difficulty is experienced although there may be slight fluid loss around the lubricator head. Fig. 2.

Spot Those Gas Zones with neutron logging

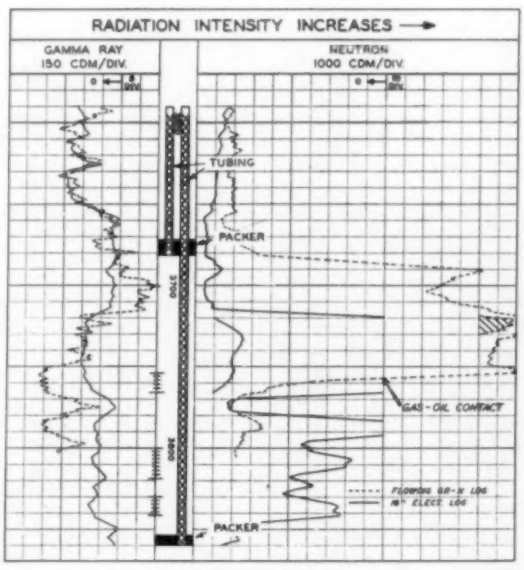
This article explains how Creole Petroleum Corp. determines the gas-oil contact by running a gamma-ray neutron log while a well is actually flowing. Results have been encouraging and the method has helped reduce the cost of workovers and well repairs.

by B. H. Bailey*, H. L. Bryant†, and N. L. Powell‡

ONE of the major problems accompanying the orderly development of solution gas reservoirs is the successful and accurate detection of gas and H.G.O.R. zones. In the prolific Miocene and Eocene reservoirs of giant Bolivar Coastal field of western Venezuela, many wells have gone to gas or H.G.O.R. The detection of gas zones has often defied all conventional formation-logging techniques; costly, time-consuming testing operations have resulted. During 1956 the gas problem accounted for 28 per cent of the workovers and well repairs in Creole's Tia Juana district.

In January 1957, Creole Petroleum Corp. concluded that the ineffectiveness of the gamma-ray-neutron log, normally used to detect gas zones, was due to the loss of control-fluid into the formation during cleanout operations. Standard well-site procedure called for the well to be killed by a suitable control fluid during cleanout and prior to logging operations. If a fluid sheath were formed around the cased-off bore hole, the normal 12 to 13-in. radius of investiga-

*Creole Petroleum Corp., geological group, Tia Juana, Venezuela. †Creole Petroleum Corp., geological group, Tia Juana, and ‡Petro-Tech Service C.A., well logging engineer, Las Morochas, Venezuela.



THIS WELL is a dual completion and the lower zone was killed. The instrument logged the upper zone through the lower tubing string. Fig. 3.

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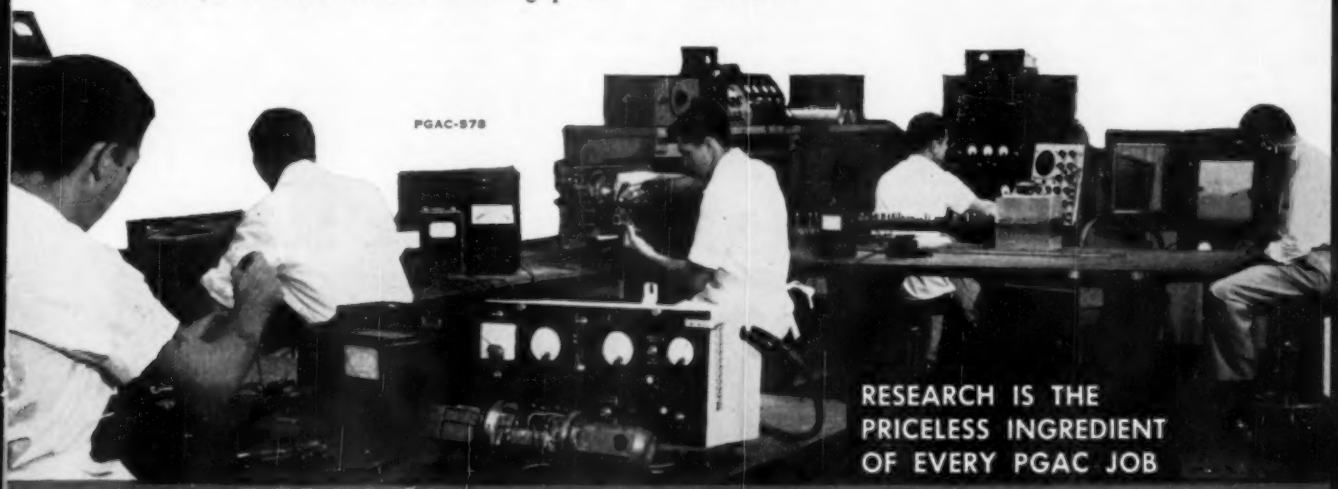

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tion of the neutron log would be inadequate.

A logging study of gas injection wells confirmed the presence of the so-called fluid sheath and called for a new logging technique. The multi-spaced neutron log, effectively used in eastern Venezuela, had previously proved unsatisfactory.[1,2]

A possible solution was to log the wells while actually producing H.G.O.R.

Field procedure . . . A technique for "flowing neutron" log was reviewed with Petro-Tech Service C.A. and the following well-site procedure was decided upon:

1. Allow the well to flow until G.O.R. is stabilized before commencing logging operations.

2. Rig up lubricator normally used during perforating operations.

3. Log through tubing with the Lane-Wells 1¾-in. 310 gamma-ray-neutron instrument—while the well is actually flowing H.G.O.R. Sinker bars to be attached enable the instrument to pass to the desired depth against flowing pressure.

Theoretically the gas could be detected within 4 to 5 hours of moving onto a well site. A test program of five wells was initiated.

Results . . . Figs. 1, 2, and 3 show results of three of the initial flowing neutron logs. In all three cases, the gas-oil contact was extremely well defined by the neutron curve and the wells were successfully repaired. In two cases, LL-894 and PB-137, the gamma-ray curve responded to the gas zone by a large deflection to the right. In both cases, the logging instrument was in the casing while the well was flowing.

The deflection on the gamma-ray curve is approximately 7 ft. above the deflection of the neutron curve. The deflection of the gamma-ray curve is due to direct and reflected radiation from the source when in very low-density fluid; i.e., flowing-gas zones. This effect is not noticed until both the gamma-ray counter and the source are above the fluid level; therefore, the gamma-ray curve is not affected until 7 ft. later than the neutron curve. The log on TJ-347 (Fig. 3) shows a much smaller deflection of the gamma-ray curve because the instrument was run down the dead fluid-filled tubing string which shielded the gamma-ray counter.

A discussion of each well follows:

LL-894, Fig. 1, Eocene, B-6; H.G.O.R. well. A test prior to logging was as follows:

Hours	2
B.o.p.d.	500
Choke (in.)	⅜
T.H.P. (psi.)	400
M.c.f.	4,503
G.O.R.	9,006
B.s. and w., per cent	0

The well was rigged up with a 30-ft. joint of tubing and a bypass lubricator head. Three sinker bars were required to run the instrument to bottom due to the high flow rate and pressure. The first log was run while the well was flowing. Various sensitivities were run for comparison purposes and to determine which sensitivity range would be best for future logs. The gas-oil contact is clearly defined at 5,455 ft. Even though the entire curve is displaced to the right above the gas level, formation character is still evident. As would be expected, the curve is useless when the instrument enters the tubing. The well was killed with 47 bbl. of oil and the logs were rerun. There is no indication of gas at any point in the well on the second run. No difficulties were encountered in the actual logging operation other than a slight fluid loss through the lubricator head.

PB-137, Fig. 3, was a high-gas-oil-ratio well completed in the Santa Barbara sand, Miocene in age. The G.O.R. while logging was 4,460. Three sinker bars were needed to run the instrument through 2½-in. tubing to bottom. During logging the tubing-head pressure rose to over 500 psi., and the flow rate to more than 200 b.o.p.d. The logging procedure used was identical to LL-894. Logs were run while the well was flowing and again after killing the well with approximately 50 bbl. of oil. The results were identical in that the strong gas show on the first log was completely absent on the second run.

TJ-347, Fig. 3, Eocene B-6, B-8 dual tubing string completion. A test prior to logging was as follows:

Hours	3
B.o.p.d.	2,370
Choke (in.)	1¼
T.H.P. (psi.)	195
M.c.f.	7,089
G.O.R.	2,991
B.s. and w., per cent	0

The lower zone (B-8) was killed and the well logged through the lower tubing string while the upper (B-6) was flowing. The neutron curve indicated the gas oil contact as in previous wells. The gamma-ray curve showed a nearly normal response through the interval logged.

Prior to moving on a well the tubing size, flow rate, pressures, choke size etc., should be checked and reviewed with the service company. If difficulty is experienced in entering the tubing because of high pressure or flow rate, a choke change may help reduce one or the other sufficiently to permit logging.

In conclusion, 11 wells have been logged using the flowing neutron logging technique with 10 successful logs. The one unsuccessful log was run immediately after swabbing the well in and before the G.O.R. had stabilized. The G.O.R.'s have ranged from 1,600-9,000 with flowng tubing head pressures up to 1,100 psi. safely handled. Creole's high success ratio may be attributed to their gravity segregated reservoirs. In the absence of gravity segregation, high solution G.O.R. reservoirs, where gas may pass into the vapor phase above the producing interval, the flowing neutron method will be ineffective. In dealing with heavy oils, where the gas is not evenly dispersed throughout the fluid, large increases in the neutron statistical will indicate the point of gas entry.

References

1. Swift, G., and Norelius, R. G., New Nuclear Radiation Logging Method: The Oil and Gas Journal, October 15, 1956.

2. Grosmangin, M., and Walker, E. B., Gas Detection by Dual-spacing Neutron Logs in the Greater Oficina Area, Venezuela: Journal of Petroleum Technology, May 1957.

BOOK

OKLAHOMA GEOLOGICAL SURVEY BULLETIN by Dr. R. W. Harris. Published by University of Oklahoma, Norman.

Nearly 30 years of research went into this bulletin. Dr. Harris is professor of geology at the university and published this bulletin as a service to the people of Oklahoma in assisting geologists to find more oil. Dr. Carl C. Branson directed the survey.

Dr. Harris is an authority on microfossils of the Simpson group. The rocks of the Simpson group are important petroleum reservoirs and the ostracodes Harris' work deals with are the best age indicators in well samples.

Dr. Harris has been engaged in research on Simpson ostracodes since 1928. His studies to 1937 were submitted as his doctoral dissertation at Harvard University.

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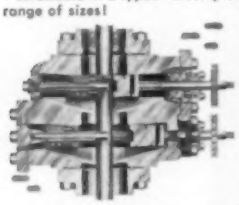

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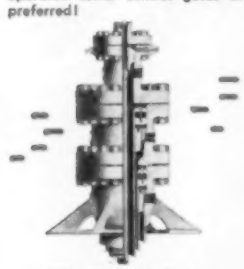

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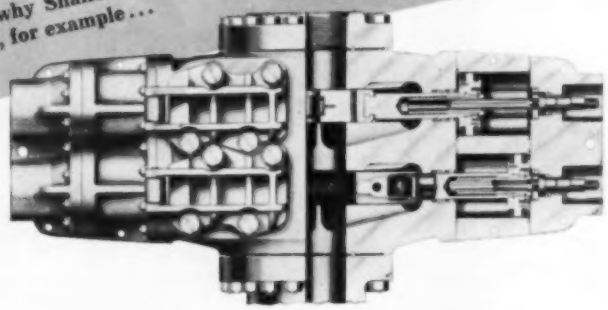

SHAFFER HYDRAULIC CELLAR CONTROL GATES

- Available in Both *Double* (illustrated above) and *Single* types. Both in choice of *Non-Rising* Locking Shafts (for those preferring maximum compactness) and *Rising* Locking Shafts (for those preferring quick indication of ram position.)
- They provide unequalled simplicity in changing rams. Simply unbolt two doors, change rams, close and bolt the doors. Rams are automatically aligned as the doors are bolted shut!
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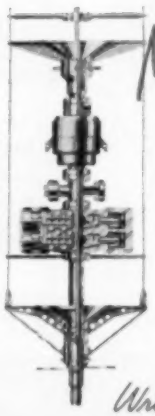

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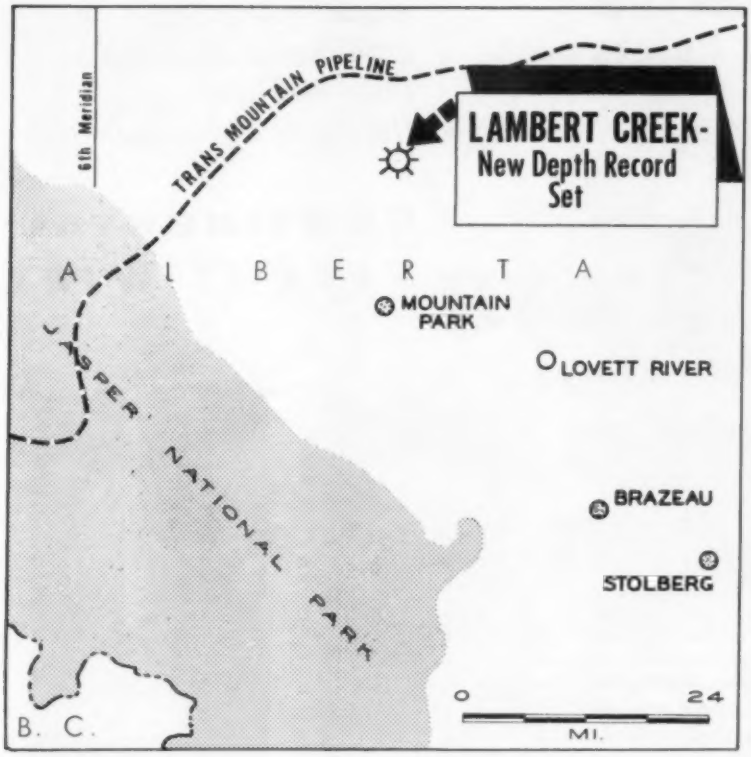

Fifteen-year footage-drilled record scheduled to fall as

Western Canada Test Heads For New Deep Mark

Arrow Drilling Co.'s Rig No. 21 under contract to British American Oil Co., Ltd., established a new western Canada footage drilled record at the British American-Triad at el 6-4 Lambert Creek, LSD 6, 4-51-21w5, wildcat on November 5. With bit No. 213 on the end of the drill-pipe the 14,443-ft. record depth of Shell's 4 Jumping Pound Unit well was surpassed. This well being backed by the Central Foothills Agreement Group, comprised of B.A., Triad Oil Co., Ltd., Royalite Oil Co. and Sun Oil Co., is situated 55 miles northeast of the summer-resort of Jasper about 145 miles west and slightly south of the city of Edmonton, along the front of the Rocky Mountains. All Canada's drilling record of 14,696 ft. will be eclipsed this week end by 6-4 Lambert Creek. Present holder of the Canadian record is the Owen Development Co. 1 Hillsburry exploratory test that was drilled a few miles off the shore of Prince Edward Island by Mobil Oil of Canada (then Socony-Vacuum Oil Co.) back in 1942.

Drill bits alone at the Lambert Creek record breaker have cost in the neighborhood of $50,000, as each is valued at approximately $230.

The contract rig, an Emsco J 1,000-1250, with a rated drilling capacity of 16,000 ft. is under the supervision of Tool Pusher F. C. Mannas. Mannas has been with Rig No. 21 since it spudded this well back on January 24, 1957. A well as having the satisfaction of bringing in a discovery at this well tool pusher and crew have had other anxious moments for when gas was encountered near the 13,000-ft. level the well blew out. It was brought under control by crew members with no damage to drilling equipment and little or no damage to the hole itself.

The discovery formation, the D1 zone of Devonian, yielded gas at rates up to 11,000,000 cu. ft. daily on drill-stem test prior to resuming drilling opeartions. The well is currently bottomed in the D2 section of the Devonian and is scheduled to test for D3 reef prospects in the area.

Lambert Creek 6-4 can be compared to the 4 Jumping Pound Unit well inasmuch as it has discovered gas higher up the hole. Unit No. 4 found gas in the Rundle section of the Mississippian and was completed in that zone at 10,270 ft. after establishing the record drilling depth. The previous western Canada record well is on production at the present time and helps to supply the city of Calgary with natural gas.

If no further discovery is recorded at 6-4 Lambert Creek and it is successfully completed as a D1 zone gasser it would be a new record for producers. Presently the deepest producing, or producable well, is Shell's 1 Waterton Mississipipan wet gas discovery. This southern Alberta test lying a few miles north of the United States border in the Waterton Park area flowed gas from the 11,332 to 12,110 ft. level.

ALBERTA

Single Discovery Reported in Alberta

A single oil discovery was chalked up in Alberta during the past week at Mobil Oil of Canada's Leslieville area wildcat in central west Alberta. Other provinces failed to indicate any new oil or gas strikes. The Mobil Oil find at its well lying 40 miles west-northwest of Red Deer city (on LSD 4, 19-39-5w5) in the basal quartz formation. The venture had previously assured its backer of indicated oil success in the Viking sand section.

The new discovery horizon when tested in the interval 7,717 to 7,767 ft., flowed natural gas at maximum rate of 1,000 M.c.f. daily and gave a pipe recovery of 700 ft. of clean oil. Subsequent testing of a lower interval gave only oil-cut mud indicating penetration of the oil pay section. This well is now being drilled towards lower objectives. It is scheduled to test all zones to and including the Cambrian to an approximate completion depth of 11,350 ft.

October Discovery Tally

Oil and gas discovery tally for the month of October 1957 showed nine oil discoveries and six gas finds at western Canada wildcat wells. Alberta operations resulted in six of the oil finds and four gas discoveries, while Saskatchewan came up with two new oil strikes and a gas discovery, and British Columbia recorded oil discov-

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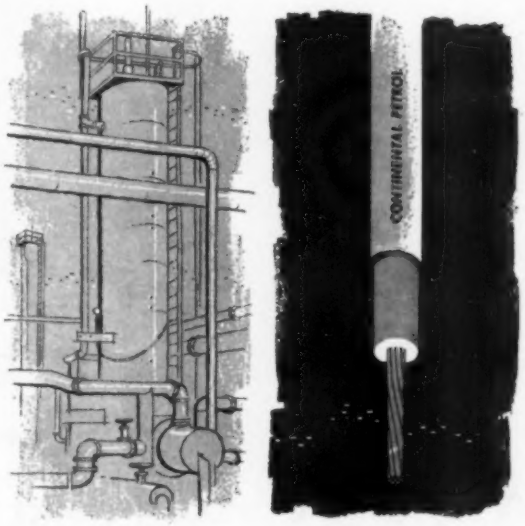

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ery at one wildcat and gas at another. The first 10 months of 1957 show 119 discoveries in western Canada. This total includes 77 in Alberta, 45 oil and 32 gas discoveries; 28 in Saskatchewan, 25 oil and 3 gas; and the remaining 14 in British Columbia, 11 oil and 3 gas strikes.

Less Than Two-Thirds Of Rigs on Active List

As of the first of November slightly less than two-thirds of the drilling rigs situated in western Canada were on the active list. The score of 211 active rigs out of an available 340 paints a very dark picture for the drilling contractor in western Canada and although winter operations will result in a number of new drilling projects not many more rigs are likely to be pressed into operation until some definite incentive is provided the oil industry. This incentive could be brought about by a number of important factors, increased crude oil markets for western oil, tax revisions that will give the Canadian operator a better break, and a definite stand on gas export—surplus to Canada's needs. Several factions in the industry are pressing for one or all three of these items at the present time. The Canadian Petroleum Association, representing about 97 per cent of all operators in western Canada has more than 390 member firms. Oil experts in Calgary have in recent weeks tried to point out to the general public of Canada that although the present recession is confined to western Canada and primarily Alberta at the present time it has and will have definite effects on the whole of Canada.

APPALACHIAN

OHIO

Good Well Added To Moreland Pool

On an outside location in the north end of Moreland pool in Franklin Township, Wayne County, Preston Oil Co. 1 F. O. Gwinn, Section 10, made 678 bbl. and 1,000,000 cu. ft. gas in a 24-hour test after fracture. Clinton sand was logged at 3,475-3,550 ft. with 20 bbl. natural.

Gage Reported at Coshocton Well

Pure Oil Co. 1 (2) Elmer Mayberry, Section 7, Perry Township, Coshocton County, with Clinton at 3,177-3,223 ft. gaged 14 bbl. natural

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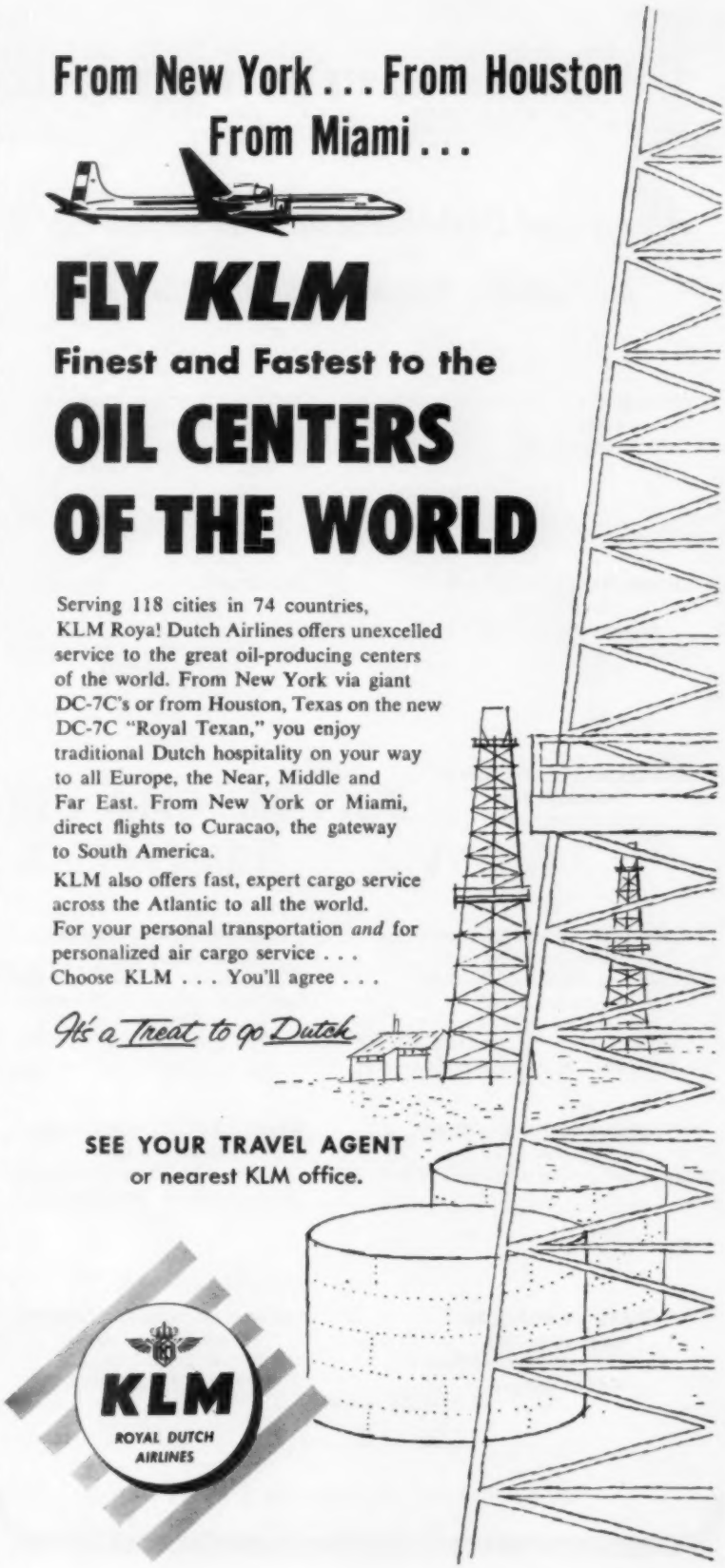

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and 629 bbl. in 24 hours after fracture.

Stepout Hits Northeast of Fallsburg

A stepout of 1 mile northeast of Fallsburg in Fallsburg Township, Licking County, made 80 bbl. during the first 24-hour test after fracture. The completion by Natol Corp. on 1 (6) Ralph Martin, Section 10, found Clinton sand at 3,031-73 ft.

PENNSYLVANIA

New Wildcat Announced In Indiana County

In Buffington Township, Indiana County, Southwest Pennsylvania, Columbian Carbon Co. has located 1 Herman George, wildcat elevation 1,990 ft., Barnesboro Quadrangle, 4.07 miles south of latitude 40 degrees 35 minutes and 3.51 miles west of longitude 78 degrees 55 minutes.

WEST VIRGINIA

Operator to Complete Green Bank Wildcat

In Green Bank district, Pocahontas County, West Virginia, Columbian Carbon Co., 1265 U. S. A. Dept. of Interior wildcat, elevation 3,394 ft., ran 10-in. casing and cemented. The rotary outfit has been moved off and cable tools in to complete the well. The Chert was at 5,500 ft., Oriskany sand 5,718-5,915 ft., and present depth of hole is 6,250 ft. This company's 1276 U.S.A. shut down at 997 ft. to move in rotary.

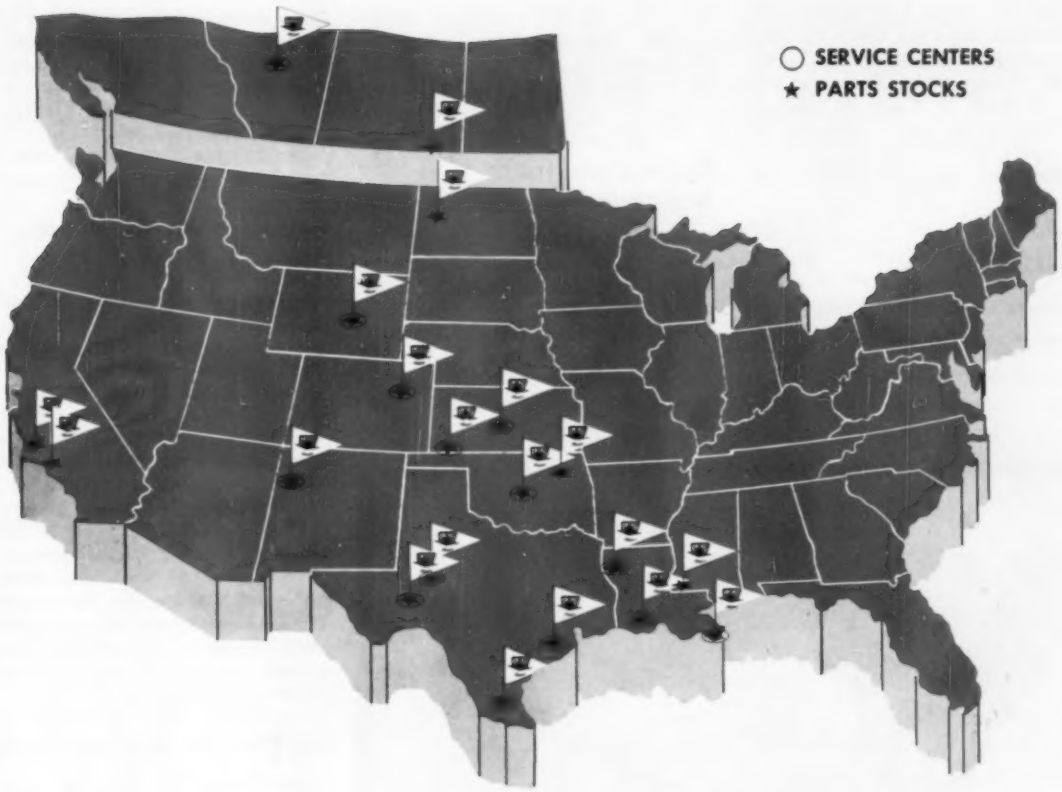
EASTERN KENTUCKY

Maxon Gas Well Finaled In Big Sandy Field

In the Pike County Sector of Big Sandy gas field, Kentucky West Virginia Gas Co. has completed 1077 E. L. Pinson as a Maxon (Mississippian) gas well. Located on Winn Branch of Raccoon Creek test topped Maxon at 1,990 ft. and had gas from 2,040 to 2,059 ft., total depth. At that depth well gaged initially at the rate of 1,917,000 cu. ft. of gas daily with a 63-hour rock pressure of 520 lb. Well was completed natural.

Testing Reported at Wallins Creek Well

In Harlan County and located on Wallins Creek of Ginseng Creek, Columbian Carbon Co. is testing at their wildcat 1 Kentenia Corp. Mississippian



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Big lime was topped at 3,668 ft. and Corniferous lime at 4,665 ft. Test was drilled to a total depth of 4,826 ft. in Silurian shale. Well was then plugged back to 4,740 ft. and the Corniferous lime sand fractured. At last report, gas was gaging 23,000 cu. ft. daily and operators continue testing.

CALIFORNIA

Tidewater Slates Deep Ventura Avenue Test

Tidewater Oil Co. announced plans to drill a deeper pool test in Section 26-3n-23w, in the eastern part of the Ventura Avenue field. Tidewater didn't reveal a projected total depth but the deepest production in this part of the field is about 13,000 ft.

Union Gets Third Mountain View Discovery

Union Oil Co. of California contiinued its record of successful wildcatting in Sections 21 and 27-31s-29e, on the west flank of the Mountain View field with a Santa Margarita sand new pool find about ½ mile east of its Stenderup pool activity. This newest discovery, 82-21 Union-Hancock-Cattani, was completed in a Miocene interval at 7,610-7,725 ft. flowing 1,200 bbl. daily of 31.8°-gravity crude through a ½-in. choke. Union took this test in NE NE 21-31s-29e to basement at 9,291 ft. and then plugged it back to 7,725 ft. for the completion.

Reserve Gets Big Vedder Discovery at North Tejon

Reserve Oil & Gas Co. reports a discovery of considerable significance with a wildcat, 388-18 Reserve-Butler-Wehr, in the north Tejon area of southern Kern County. This test, a joint venture with Standard Oil Co. of California, Western Operations, Inc., tapped a Vedder zone pool in a 390 ft. interval at 11,590-11,980 ft. Initial production varied from 649 bbl. daily rate through an 18/64-in. choke to 1,319 bbl. daily through a 24/64-in. choke. The crude tested at 34° gravity. The well is located about 2 miles north of the Tejon-Grapevine field. Standard-Western owns a half interest in the well and 2,000 acres around the discovery.

Bix Oxnard Well for Texaco

The Texas Co. gave the recently developed southeast area of Oxnard field another big producer with a 984 bbl. daily well in NE SE 11n-20w of Ventura County. The well, 4 Diedrich, was brought in flowing 23.9°-gravity crude from the Sespe formation at 6,532-93 ft. through a 16/64-in. choke.

The Texas Co. Taps New Pool at Tejon

The Tejon-Grapevine field of southern Kern County yielded up two good discoveries in the same week. In addition to the big Vedder find by Reserve Oil & Gas Co. 2 miles north of the field, The Texas Co. reported a new pool discovery with a wildcat about ½ mile southwest of the western area of the Tejon field. The well, 2 Tejon Ranch B, was completed pumping 154 bbl. daily of 21.3°-gravity crude from perforations at 5,370-5,423 ft. The choke was 16/64-in.

ILLINOIS BASIN

ILLINOIS

Illinois Oil Well Drilling Steady in October

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of the year continued in October, and production showed an increase during the month, according to the Geological Survey of the State Department of Registration and Education.

A total of 239 wells were completed in October, a 4-week period. For the first half of 1957, the number of completions averaged about 46 wells a week. Thus far in the second half of the year the weekly average is 59. The 239 completions for October include 95 oil wells and 1 gas well, or 40 per cent successful.

The estimated production for October is 7,193,000 bbl. as compared with 6,690,000 bbl. in September and a monthly average of 6,280,000 bbl. for the first 10 months of 1957.

There were no discoveries of new oil pools, but two extensions to pools: one each to Cooks Mills Consolidated in Coles County, and Greenville in Bond County. The extension to Greenville revives this pool, which was formerly an abandoned gas pool.

Three new pays were discovered in October, the Aux Vases sandstone in Hill East pool in Effingham County, the Waltersburg sandstone in Ab Lake pool in Gallatin County, and the McClosky limestone in Phillipstown South pool in White County.

KANSAS

Gage Taken at New Meade County Discovery

Northern Natural Gas Co. completed 1 Flagel "A" in C NW SE 20-31-29, 2 miles southeast of Hockett field in Meade County. The wildcat, located 6 miles northeast of the town of Plains, flowed 2,033 M.c.f. of gas per day through perforations at 5,545 ft. in the Mississippian. Ther were six casing perforations at the above point.

LOUISIANA

NORTH

Tuscaloosa Produces In Tensas Parish Wildcat

Jett Drilling Co., Inc., is verifying discovery of Lower Tuscaloosa oil production in the Cow Slough area, 9 miles northwest of St. Joseph, in Tensas Parish.

Its 1-H Fisher, 3,600 ft. north of its initial well (1-G Fisher), flowed 90 bbl. of 43.5° - gravity oil per day through 3/32-in. choke when starting completion tests. Its pay, in hole drilled to 8,501 ft., is perforated at 8,393-8,403 ft.

The initial well flowed 1½ to 3 bbl. of oil per hour through 7/64-in. choke for a short time before packer started leaking. It has been shut in, waiting on a workover rig. Its perforated interval is 8,396-8,400 ft.

Rodessa Gas Discovery Indicated in Catahoula

A major extension of Rodessa production appears to be in the making by a deep test drilled by Austral Oil Exploration Co., Inc., of Houston, and Crescent Producing Co., of Monroe, La., in Sicily Island field, Catahoula Parish.

Production so far at Sicily Island has been from Tuscaloosa sands of Upper Cretaceous age. Nearest Rodessa (Lower Cretaceous) production in Louisiana is in Simsboro field, Lincoln Parish, about 80 miles northwest. In adjoining Mississippi, nearest Rodessa production, is 85 miles northeast in Bolton field, west of Jackson, in Hinds County.

As this is written, the Austral-Crescent well (1-A Tensas Delta) has not been completed, nor tested. Prospects for Rodessa production are

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based on gas pressures encountered in sand logged at 11,303-32 ft. Hole has been deepened through this zone to 11,400 ft., and casing run with a view toward completing in the indicated pay.

There has been relatively little drilling in eastern Louisiana below the present Tuscaloosa and shallower producing horizons. Nearest deep test to the Sicily Island venture has been in Lake St. John field, in Tensas Parish, more than 15 miles east. It was dry in the lower Glen Rose section, penetrated 497 ft.

SOUTH

Deep Discovery May Link Two Iberia Parish Fields

A deep test located about midway in the 4-mile gap between Big Bayou Pigeon and Bayou Postillion fields, in eastern Iberia Parish, is proving productive of gas and condensate.

It is California Co.'s 3 Williams-4, in 28-12s-11e, which is testing perforated pay at 11,827-99 ft. Through 5/32-in. choke, its flow is at the rate of 48 bbl. of 58.2°-gravity condensate with 2,740,000 cu. ft. of gas per day. Pressure is 4,500 psi.

Big Bayou Pigeon field, on the west, was discovered early in 1955 by Union Oil Co. of California. It is oil-productive from at least three separate sands ranging in depths from 8,250 to 9,700 ft. Twelve producers have been completed. Bayou Postillion, on the east, discovered by Humble Oil & Refining Co. later the same year, has six wells with oil production from three zones from 11,650 to 12,450 ft.

Abbeville Wildcat Opens New Gas-Condensate Field

Texas Gas Exploration Co. has completed a gas-discovery well 2 miles south of Abbeville field, southwest of Abbeville, in Vermilion Parish.

The well, 1 Victoria Noel, in 5-13s-3e, is productive from perforated interval at 10,935-40 ft. with potential of 2,620,000 cu. ft. of gas and 19 bbl. of 49.9°-gravity condensate per day, tested through ⅞-in. choke. Flowing pressure is 3,985 psi.

Third Couba Island Well Confirms Oil Production

California Co.'s third well for the new Couba Island field, on the southwest side of Lake Cataquatche, in southeastern St. Charles Parish, confirms the oil discovery made in its second well.

The field's discovery well, 1 Tim-

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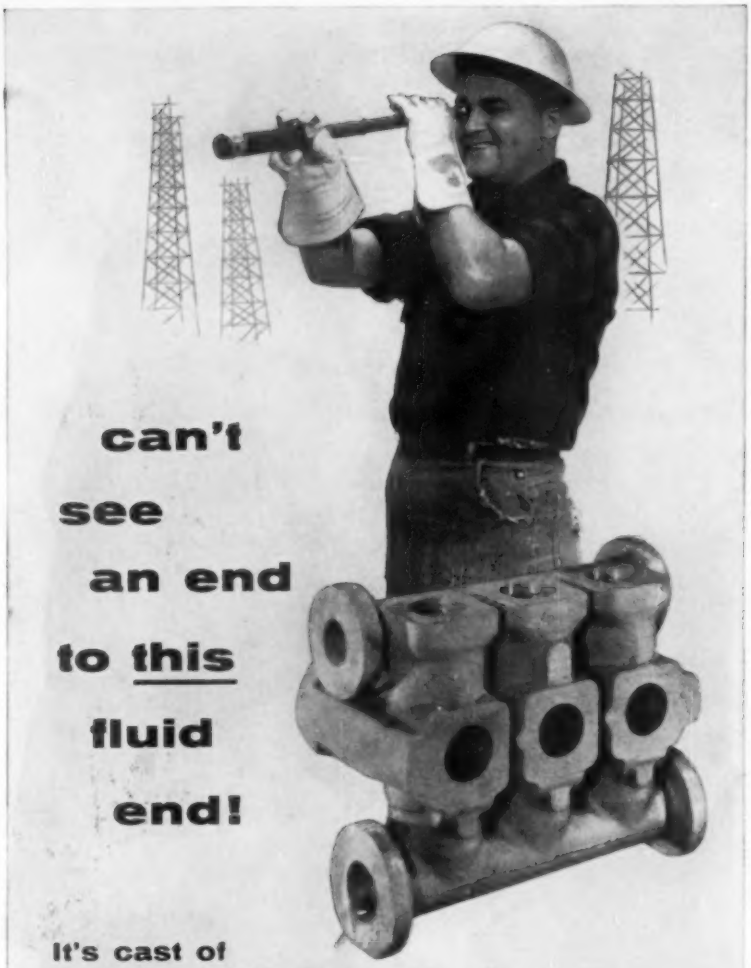

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kens, completed last June, was a small gasser from pay at 5,836-44 ft. The second well, 1,600 ft. northwest, was completed last month as the field's oil-discovery well. Its pay was perforated at 7,923-44 ft.

The new well, located southeast of the discovery well, has been completed as an oil producer in the 7,900-ft. sand, perforated at 7,927-50 ft. It is good for 117 bbl. of oil per day, flowing through small chokes.

Drilling now is under way at the field's fourth test, located south of the new well.

LOUISIANA OFFSHORE

Four Pay Zones Indicated In Bay Marchand Wildcat

Phillips Petroleum Co.'s second attempt to get production on its wildcat prospect in Block 5, Bay Marchand area, offshore from Lafourche Parish, is proving successful.

Gas and condensate production is virtually assured in at least four separate zones between 10,850 ft. and 11,250 ft. found in the company's 2-B OCS-O223 (State Lease 1369).

This well was drilled in deflected hole from the surface location of the first test, abandoned last May, to a bottom location 1,320 ft. east.

The first test, drilled to 11,193 ft., encountered promising oil and gas showings, ran casing, and tested several perforated intervals, but failed to develop commercial production.

The second well is perforated at 11,240-46 ft., 11,097-11,106 ft., 10,856-62 ft., and 10,657-82 ft. It tested 4,600,000 cu. ft. of gas with 112 bbl. of condensate per day from the bottom pay, 5,250,000 cu. ft. of gas with 37 bbl. of 54.1°-gravity condensate from the next lower pay, and 4,900,000 cu. ft. of gas with 49 bbl. of 52.8°-gravity condensate from the third. Flows were through ¼-in. choke in each case. The uppermost sand has not been tested as this is written.

Location of this discovery, the nineteenth this year in Louisiana's offshore areas, is about 4 miles southwest of Bay Marchand field, and about the same distance southeast of Timbalier Bay field. It is about 3 miles northeast of Gulf Oil Corp.'s deep field, opened last February, in Block 21, South Timbalier Area.

MICHIGAN

Good Dundee Oil Show Reported at Saginaw

Roush and Voorhees 1 Blackmer SE SW 26-10n-3e, Saginaw County,

carried good show oil in Dundee dolomite at 2,858-63 ft. and probably will fracture. Test is southwest offset to same operators' 1 Ostrander NE SE 26-10n-3e, completed at 2,308 ft. for 49 bbl. Traverse oil discovery.

Hillsdale Well Misses Trenton Pay

Perry and Gordon 1 Nelligan SE NE 9-5s-3w, Hillsdale County, ¾ mile due west of Scipio field oil producers and first major step-out apparently missed Trenton dolomite production zones from which other wells are producing. Trenton was logged at 3,523 ft. and well drilled ahead at 3,852 ft. without reported oil or gas shows.

Tests Under Way at Possible Traverse Strike

Three Lakes Oil Co. 1 Clark SW NW 2-4n-1e, Ingham County, under test as possible Traverse oil discovery at 2,468 ft. for past month, will be deepened to Dundee. Swab tests showed 10 to 1 water and comparatively small amount of oil.

MISSISSIPPI

Eucutta Joins List of Lower Cretaceous Fields

Deeper drilling is adding Eucutta, in Wayne County, to the list of southern Mississippi fields in which Lower Cretaceous sands have proved productive. The new discovery at Eucutta, one of the state's older and more important shallower fields, is expected to provide new incentive for deeper exploration in many of the state's other older fields.

The Eucutta discovery is in an old hole which Gulf Oil Corp. has deepened from its former dry depth of 5,727 ft., in Upper Cretaceous-Tuscaloosa, to 9,882 ft., in the Lower Cretaceous-Rodessa section.

The well, 1 Charles Green, is perforated at 8,067-69 ft., opposite Paluxy sand logged at 8,054-75 ft. It is being tested through various chokes, but in a late 19-hour gage through 11/64-in. choke it flowed 324 bbl. of 42.5°-gravity oil, recording pressure of 950 psi. on the tubing side and 690 psi. on the casing. Flow during a 5-hour gage through 5/32-in. choke was 59 bbl. Gas-oil ratio is 479 cu. ft. per barrel.

Previous production at Eucutta, discovered in 1943, has been from Eutaw (Upper Cretaceous) sands at depths of 5,100 to 5,300 ft. Location of the Paluxy well is near the center of the field, in the graben area between field's east and west sectors.

Eucutta is the nineteenth southern Mississippi field in which Lower Cretaceous sands have been found productive.

NORTH DAKOTA

New Fields Named by Industrial Commission

The State Industrial Commission of North Dakota has labeled new discoveries in various parts of the state. The Leach Oil Co. 1 Kalanek in SW NW 32-140n-96w, opens Dickinson field. Spartan Drilling Co. 1 Ecklund, SW NW 9-162n-95w, Divide County discovery, opens Baukol-Noonan field.

OKLAHOMA

SOUTH-CENTRAL

Oil Creek New Pay At Southwest Noble

The Oil Creek Ordovician sand is an indicated new-pay discovery for McClain County's Southwest Noble

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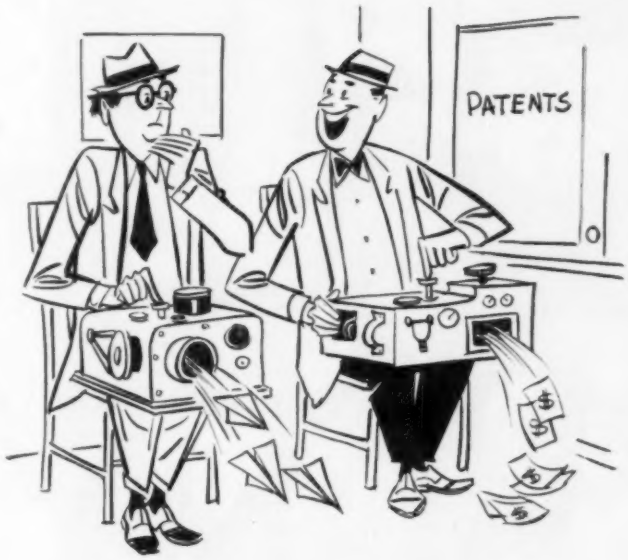

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pool. The well is Cooperative Refinery Association and Goff-Leeper Drilling Co. 1 Thompson-O in C NE SE 8-7n-2w, a north offset to the sandy dolomite field discovery well.

Recovery on drill-stem test at 9,142-59 ft. was 5,000 ft. of oil. Drilling continues downward.

The discovery well of this McClain County field was Goff-Leeper Drilling Co.'s 1 Sasser in C SE SE. It flowed 400 bbl. of oil per day on ¼-in. choke from perforations at 8,291-98 ft.

Dual Completion Extends North Payne Production

An extension discovery in North Payne field, McClain County, extended production to the north. The well is Rockwin Oil Co. 1 Hester-Croxton, C NE NW 5-5n-3w. The well was dually completed in the Hunton at 9,062-78 ft. for 151 bbl. of oil in 12 hours on 10/64-in. choke after acidization; 102 bbl. in 4½ hours on 10/64-in. choke from the Bromide sand at 10,206-11 ft.

This dual completion at North Payne is in the same general area where Sinclair Oil & Gas Co. recently enlarged Northeast Payne pool at their 1 Hawkins-Little in C NW NE 9-5n-3w. That well was completed in the same zones.

PANHANDLE

Another Gas Well Finaled In Camrick Field

Cities Service Oil Co. 2 Randles-A, SE SE NW 17-2n-18eCM, is a new gas producer in Texas County's part of Camrick field.

The well flowed 41,597 M.c.f. of gas per day, open flow potential, from perforations at 6,342-52 ft.

SOUTH

Second Pay Added To New Marlow Field

A second pay zone for the new field in the East Marlow area of Stephens County is reported at Goff-Leeper Drilling Co. 1 Kindred, C SW NW 15-2n-7w. The Kindred well, second test in the new pool, flowed 13½ bbl. of oil per hour on test at 7,476-7,515 ft.

Gas Well Completed North Of Loco In Stephens

A Pennsylvanian conglomerate gas well was completed north of the Loco area in Stephens County by Parker Drilling Co.

The 1 Roberts, SW SW NW 29-2s-5w, east of the Woolsey district, flowed open 20,000 M.c.f. per day from perforations at 2,915-26 ft. Total depth is in the Arbuckle at 3,041 ft.

SOUTHWEST

Operator Tests Gas At Northwest Gotebo Well

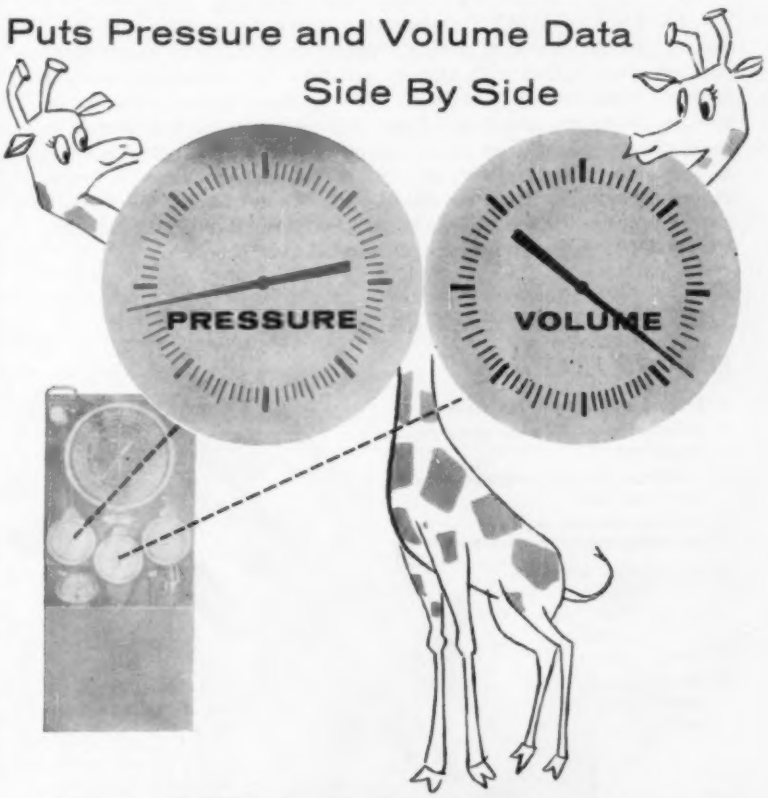
Gas is being tested at a well in the Northwest Gotebo area of Washita County. The well is Pan American Petroleum Corp. 1 Dale, SW SW SW 34-8n-16w. It flowed 2,722 M.c.f. of gas per day on 23/64-in. choke and some distillate. From perforations at 5,597 to 5,752 ft. it flowed 3,479 M.c.f. per day on 30/64-in. choke.

NORTHWEST

Tonkawa Well Indicated At Southeast Stockholm

A lower Tonkawa - Pennsylvanian sand oil well is indicated for Southeast Stockholm field in Harper County at Eason Oil Co.'s 2 Eldin Campbell, C E½ SW NW 21-26n-23w.

It Takes Two – Only MARTIN-DECKER Puts Pressure and Volume Data Side By Side



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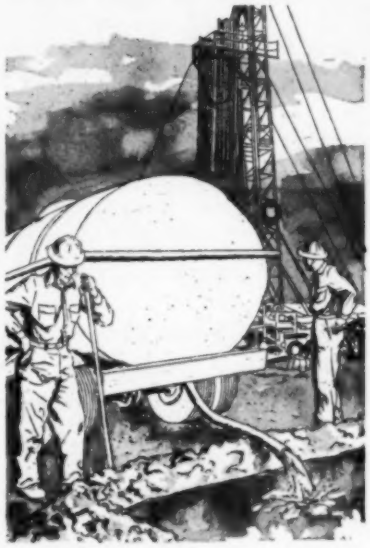

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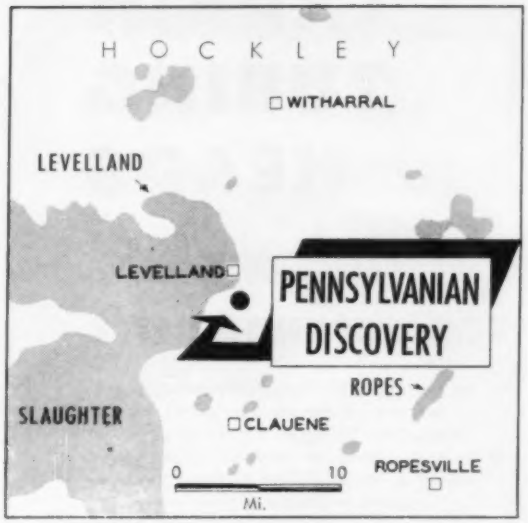
TEXAS

600-Bbl. Completion Extends Pennsylvanian Play 7 Miles to West



Felmont 1 Phillips opened Canyon pool southeast of shallow oil in Levelland field.

PENNSYLVANIAN production moved about 7 miles to the west, in central Hockley County, upon completion of Felmont Oil Co. 1 Phillips. Initial potential of the discovery was 600 bbl. of 42°-gravity oil a day.

Felmont 1 C. M. Phillips is located just southeast of the corporate limits of Levelland, in SW SW Labor 20, League 28, Hood County CSL Survey. There are no nearby dry holes or deep tests. Nearest production is from the San Andres (Permian) in Levelland field.

The well's potential was based on a flow test which gaged 225 bbl. of oil, plus 17 bbl. of water, in 9 hours, flowing through ½-in. and ¾-in. chokes. Completion was without acid treatment, from perforations at 10,120-30 ft. Flowing tubing pressure was 175 psi. Gas-oil ratio was 463:1. Formation tops were: Canyon 9,543 ft., and Strawn 10,110 ft.

Hockley County gained another deep test 8 miles east of Levelland at Pan American Petroleum Corp. 1 Sallie Duncan. Projected depth is 10,900 ft. Location is NW NW of Labor 20, League 736, State Capitol Lands Survey, Abner Taylor Subdivision. This places it about 2 miles northeast of Pennsylvanian production in Hoblitzelle field.

In northeastern Hockley County, production tests in a field development well have assured the North

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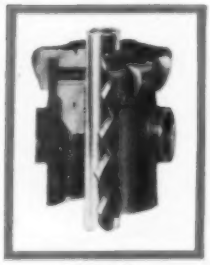
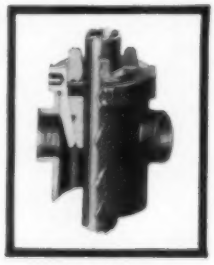


TYPE R



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Smyer field its fifth Strawn, and third Canyon producer. Honolulu Oil Co. 26-A Elwood, Section 32, R. M. Thompson Survey, flowed 254 bbl. of new oil through 7/64-in. choke after acid treatment of the Strawn through perforations at 9,992-10,000 ft. This is a northwest extension to present Strawn production.

Canyon production was indicated earlier when the well flowed 103 bbl. of oil in 2 hours and 20 minutes on drill-stem test at 9,625-49 ft.

WEST CENTRAL

Nolan County Well Is Mississippian Prospect

Skelly Oil Co. 24-A Sears, an Ellenburger test in the Nena Lucia and Vene Madre area of western Nolan County, indicated production from the Mississippian chert.

Operators reported a 4-hour drill-stem test at 7,160-7,200 ft. Gas surfaced in 3½ minutes and oil in 2 hours. The well flowed 31.16 bbl. of 48°-gravity oil in 2 hours and 10 minutes, and operators reversed out an additional 14 bbl. of oil from the drill pipe. Flowing pressure ranged from 175-555 psi.; shut-in pressure was 1,825 psi.

A later test of the Mississippian, at 7,204-60 ft., recovered 90 ft. of mud and oil, estimated to be 10 per cent oil; 90 ft. of heavily oil-cut mud and 418 ft. of salt water. On some reports this section was identified as Ellenburger.

A previous test in the Caddo at 7,073-88 ft. flowed gas but recovered mud and salt water, and a test of the Strawn reef at 6,855-6,960 ft. recovered 15 ft. of slightly gas-cut mud.

Location of 24-A Seras is SW NE Section 179, Block 1-A, H&TC Survey, 6 miles west of Maryneal townsite.

Tannehill shows . . . TXL Oil Corp. 2-C Nolan fee, a 6,500-ft. development well in the Beckham (Strawn and Ellenburger) field in east-central Nolan County, reported flowing oil while drill-stem testing the shallow Tannehill sand.

Drill-stem test in the sand was run from 3,600-35 ft. Oil flowed in 30 minutes, and was turned into pits for 30 minutes, making an estimated 10 bbl. an hour. Drilling continued after the test. Location is in Section 69, Block 20, T&P Survey.

The field opener, Champlin Oil & Refining Co. and R. J. Caraway 1 Beckham, recovered oil or oil-cut mud on tests in the Tannehill between 3,604-13 and 3,613-32 ft. This well was dually completed from the

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Strawn at 5,447-79 ft. and the Ellenburger at 6,183-6,255 ft.

Baylor Well Makes Heavy Oil Flow

A. R. Dillard 1-54 Upshur County School Land, 7 miles southeast of Seymour in Baylor County, has been completed as a Mississippian discovery.

While drilling, the well blew out and operators were unable to land casing below 1,030 ft. Production, from open hole section at 5,220-34 ft., gave the well a completion potential of 979 bbl. of oil a day through 24/64-in. choke. Casing pressure was 310 psi. Gravity was 39° and gas-oil ratio was 380:1. Operators said they would produce the well for a time, then attempt to run casing and tubing in the hole.

Location is in Block 54, Upshur CSL Survey. Nearest Mississippian production is in Rendham field, 9 miles to the northeast.

NORTH

Discoveries, New Pays In North Texas Areas

Discoveries, prospects and new-pay openers were in the week's reports from North Texas fields.

Warren Petroleum Corp. has completed a Caddo conglomerate discovery in west central Wise County, approximately 8 miles west of Bridgeport.

The well is 1 L. O. Fancher, located in the S. Hewess Survey, A-371. On final test the well flowed 167 bbl. of 40°-gravity oil a day through 16/64-in. from perforations at 4,600-22 ft. Tootal depth was 5,764 ft.

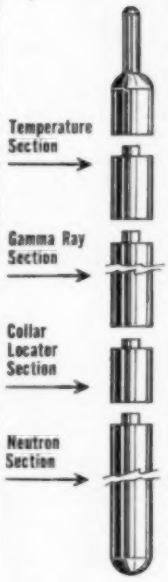
Flowing pressure was 135 psi., with gas-oil ratio of 247:1. No. 1 Fancher is 1 mile southwest of 4,732-ft. production.

Lone Star Producing Co. has filed application for a 6,000-ft. conglomerate exploration in southwestern Wise County. The firm's 1 Craft Water Board, Unit 10, will be on a 352-acre lease in Ruben Fisher Survey, A-307. Drillsite is ½ mile north of Boonsville townsite, and ½ mile northeast of Lone Star 1 Craft Water Board, Unit 3, which is a shut-in gas well.

Young County new pay . . . S. D. Johnson 2 S. R. Dozier has opened Chester sand production in the Ed Bishop (Mississippian limestone) field, 12 miles southwest of Newcastle.

On potential test the well flowed 116 bbl. of 43°-gravity oil a day

Produces Six Logs on Single Run



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5. Neutron, 5" per 100'
6. Casing Collar Log, coming out of hole.

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Crane, Texas Phone 3574

through 14/64-in. choke, from pay at 4,292-4,307 ft. Gas-oil ratio was 863:1. Location is Block 12, Young CSL Survey.

GULF COAST

Jefferson County Wildcat Opens New Oil Production

Meredith & Co. has recorded its fourth discovery in Jefferson County this year. It is 1½ miles west of Cheek, where oil production is being opened from pay at 8,005-10 ft.

The new discovery well, 1 Weed, is about a mile southwest of Lower Hackberry production in South China field. It is a little more than a mile northeast of the company's Upper First Hackberry oil-discovery well of Boyt field.

A daily flow rate of 204 bbl. of 37.3°-gravity oil was registered by the well during tests through ⅛-in. choke. This was with gas-oil ratio of 775 cu. ft. per barrel and pressure of 1,350 psi.

Three of the company's discovery wells are oil producers. The other found gas and condensate.

Gas-Condensate Discovery Indicated in Montgomery

Discovery of another gas-condensate field is indicated in pre-potential testing at Michel T. Halbouty's wildcat 2 miles south of Fostoria, in the far-eastern corner of Montgomery County.

The prospective well flowed an ungaged amount of gas and condensate while cleaning. Pay is perforated at 10,879½-91½ ft. Flowing pressure through ¼-in. choke was 220 psi.

Location is southwest of the one-well Fostoria field, discovered in 1942 and productive of gas from a 5,800-ft. Yegua sand. It is 4½ miles northeast of gas and oil production in Splendora field.

Cockfield Produces in Polk County Discovery

Oil Reserves Corp. has an indicated Yegua-Cockfield oil-discovery well a mile southwest of West Segno field, in southeastern Polk County.

It is at the operator's 1-K Kirby-Stephenson, now being completed with pay perforated at 5,379-81 ft. As this is written, no report has been received of the well's productivity except that it flowed oil and gas while cleaning. Hole was drilled to 6,856 ft.

Another test is being started by the same company about 1,320 ft. northeast in an attempt to confirm the discovery. Nearest production at West Segno also is from a 5,300-ft. Yegua-Cockfield sand.

Location is less than ¼ mile north of the Hardin County line.

Shallower Pay Opened in New Galveston Bay Field

Sun Oil Co. has completed its fifth well in its Umbrella Point field in the northern sector of Galveston Bay. It is productive from two sands, the shallower of which, perforated at 7,683-91 ft., gives the field its second pay zone. The deeper pay, productive in previous wells, is perforated at 8,261-69 ft.

The new pay, designated as the F-1-A Frio sand, produced at the rate of 168 bbl. of 40.2°-gravity oil per day through an XX34 choke. Gas-oil ratio was 786 cu. ft. per barrel, and pressure 875 psi. The deeper zone tested 225 bbl. of 39.3°-gravity oil

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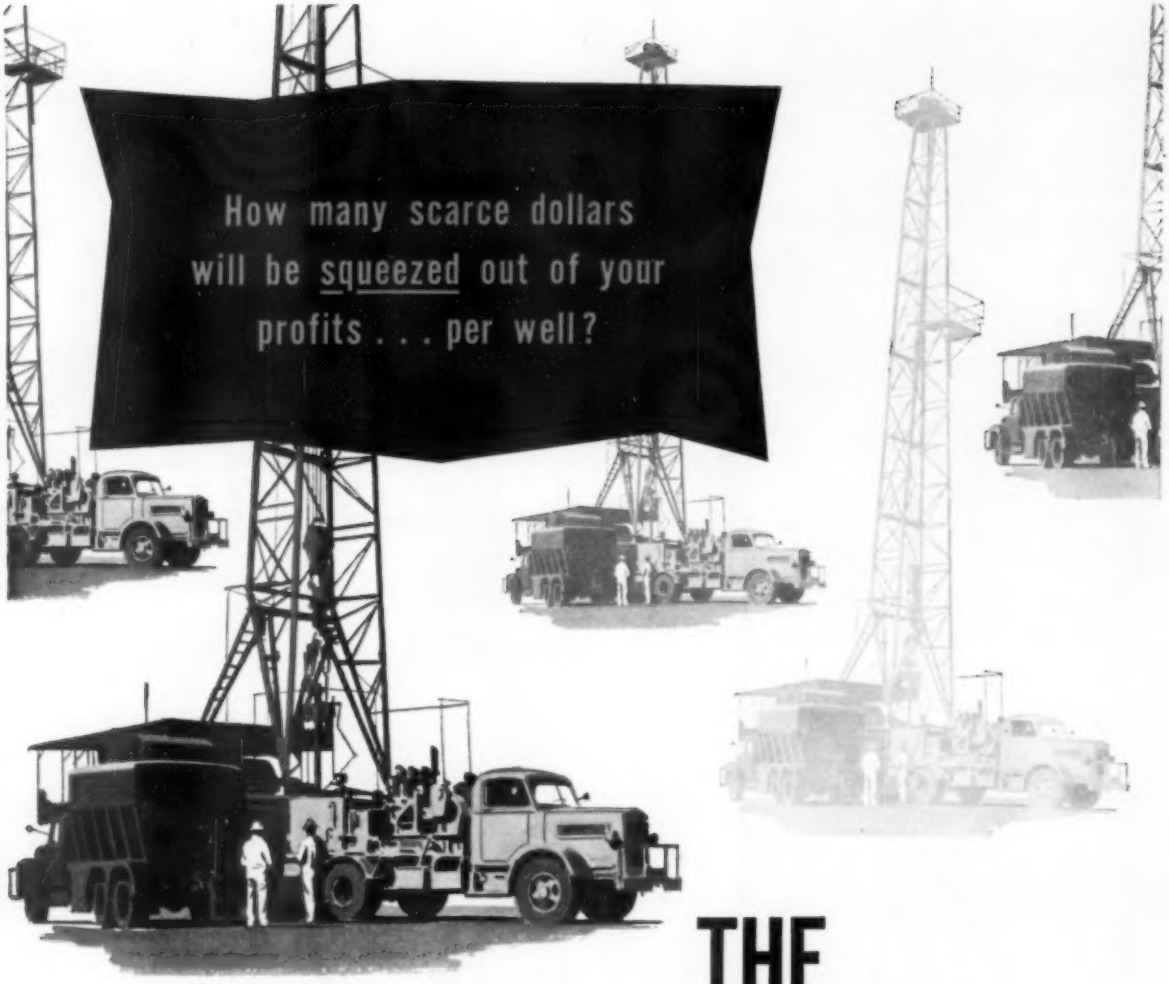

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per day through an XX35 choke, recording pressure of 1,050 psi., and gas-oil ratio of 702 cu. ft. per barrel.

The field, located 3 to 4 miles southeast of Cedar Point, off Chambers County's shore line, was discovered last May. Sun is continuing steady development.

Second Dexter Produces In Madisonville Discovery

Another Dexter zone is proving productive in T. C. Wildman's second well in the Madisonville area, in Madison County.

Perforated at 9,325-30 ft., it is about 100 ft. deeper than the first Dexter sand from which Wildman's initial well is productive.

The latter producer, 1 Heath, completed last July, is designated as the discovery well of South Madisonville field. It is south of the Madisonville Woodbine field. Pay is perforated at 9,216-48 ft.

The new well, 1,300 ft. northeast on the same lease, is on the east flank of Madisonville field. It is rated good for 304 bbl. of 31.8°-gravity oil per day through ⅜-in. choke. Gas-oil ratio is 724 cu. ft. per barrel, and pressure 950 psi.

Wildman is starting another well on a 40-acre location northwest of the new producer.

Hartburg Area Step-Out Opens New Oil Reservoir

Texas Gulf Producing Co. and Rowan Oil Co. have a new-pay discovery in a step-out well on the north side of Hartburg field, in southern Newton County. It is their 6 Morgan, completed for 127.63 bbl. of oil per day through 9/64-in. choke from perforations at 7,355-62 ft. Flow is with gas-oil ratio of 775 cu. ft. per barrel and pressure of 1,000 psi. Hole was drilled to 7,901 ft.

Southeast Harris County Gets New Vicksburg Field

A wildcat located 2 miles north of Seabrook, on the west shore of Galveston Bay, in the southeastern corner of Harris County, has been completed as a gas-condensate producer from Vicksburg sand, perforated at 9,593-9,634 ft.

Nearest other production is in the Clear Lake area, 5 miles northwest. North League City field is 7 miles southwest, and Cedar Point field, in Galveston Bay, about the same distance northeast.

The new discovery is by Universal Petroleum Corp., Clay Oil & Gas Corp. and Southwest Oil Corp. at their 1 J. W. Blalock estate, in the Ritson Morris Survey. The well is rated good for 26,000,000 cu. ft. of gas per day (absolute open-flow potential). Liquid recovery is 75 bbl. per M.M.c.f.

East Millican Discovery Records Large Gas Flow

Potential tests rate Lone Star Production Co.'s discovery well of East Millican field, in Brazos County, good for 47,000,000 cu. ft. of dry gas per day. Flows of the 4-point gage ranged from 1,816,000 cu. ft. per day through ¼-in. choke with pressure of 1,076 psi. to 4,026,000 cu. ft. per day through ⅜-in. choke with pressure of 1,050 psi.

The well, shut-in without gaging since its completion last December, is productive from Sparta sand, perforated at 2,593-99 ft. Its total depth was 4,894 ft. It was drilled as 1 Lena Williams. Location, in the A. Millican Survey, is about 2 miles northeast of Millican, and about 3½ miles northeast of Millican field.

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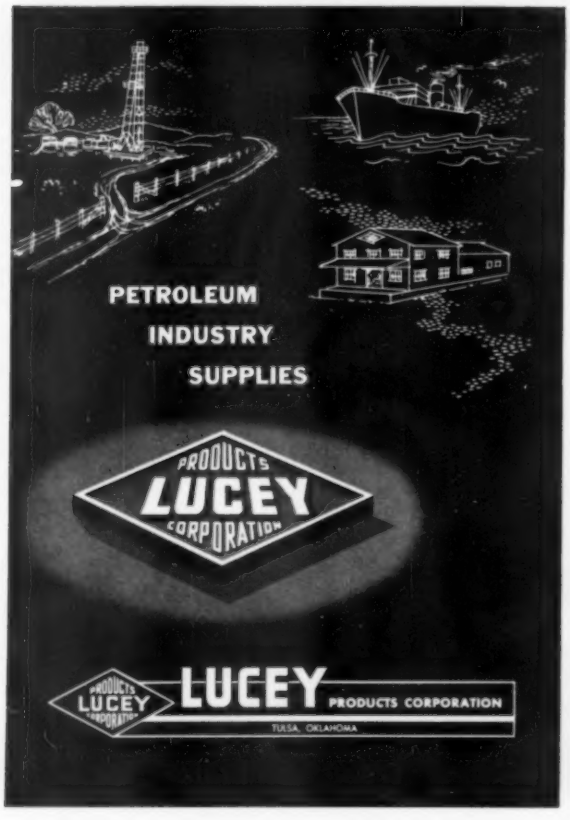

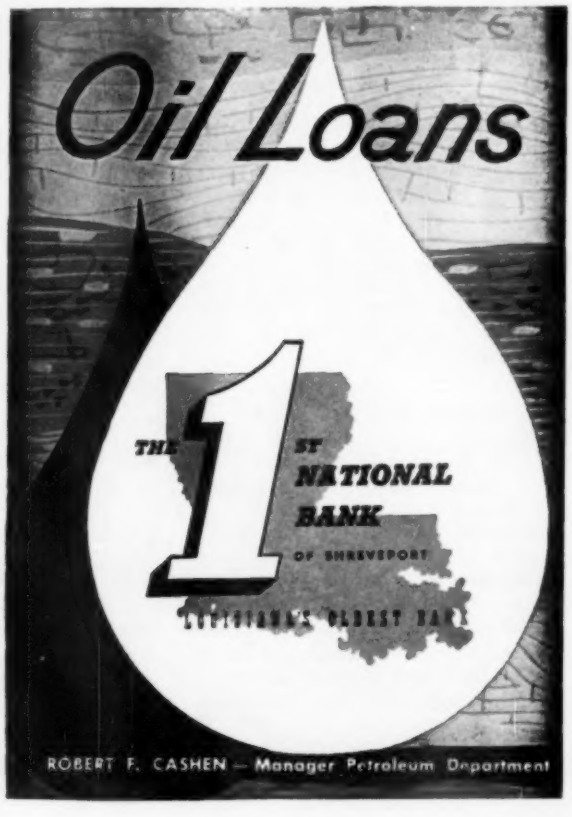

PANHANDLE

Ochiltree Outpost Well Completed in Des Moines

Shamrock Oil & Gas Co. 1 Dan W. Manning, ½ mile east of Twin-Des Moines field in northwestern Ochiltree County, was completed flowing 480 bbl. of oil per day on ¼-in. choke from Des Moines-Pennsylvanian perforations at 6,398-6,426 ft. Location is 4 miles northwest of the town of Farnsworth in Section 43, Block 4, GH&H Survey. Gas volume reached 200 M.c.f. per day.

WASHINGTON

Sunshine Mining Perforates Second Ocean City Test

Sunshine Mining Co. was swabbing to test 2 J. W. Tanner-Medina after gun perforating an interval at 4,162-78 ft. Two other intervals at 2,590-2,602 ft. and 3,000-41 ft. tested 120 bbl. daily and 75 bbl. daily on earlier tests. This well is Sunshine's first offset to the Ocean City discovery. It is northwest of 1 Medina.

ROCKY MOUNTAINS

WYOMING

Sherwood Unit Well Finaled in Natrona

Pan American Petroleum Corp. has completed a semiwildcat well in the Sherwood unit of Natrona and Converse counties, Wyoming. The well is the second drilled in the 3,865-acre federal unit, a discovery in the Frontier and an extension of productive area ½ mile west of the field discovery well.

Pan American-Lion Oil Co. 2 Sherwood unit, located in 4-40n-77w, flowed 515 bbl. of distillate and 3,240,000 cu. ft. of gas a day through a 10/64-in. choke.

The Frontier was topped at 9,531 ft. with total depth at 11,015 ft., plugged back to 9,750 ft. The field discovery well, the 1 Sherwood Unit, was completed originally in the Lakota in 1954. Later, the well was recompleted in the Muddy for an initial production of 181 bbl. of oil a day.

The 2 Sherwood proved not commercially productive in either the Muddy or the Lakota. A drill test of the Frontier on the 1 Sherwood indicated that it was not commercially productive for that well.

Pan American is operator of the unit and owns 71.65 per cent of the total unit, 80 per cent of the committed acreage of the unit and 62.5 per cent of the proved participating area surrounding the 1 Sherwood. Lion owns 37.5 per cent of the participating area. New participating acreage will be assigned to the 2 Sherwood as a result of the completion. Participation will be based on surface ownership. Pan American and Lion are the only operating companies in the committed unit and participating areas.

Rolf Lake Discovery Completed in Fremont

Phillips Petroleum Co., Carter, Sinclair and Kerr-McGee have completed the 1 Tribal in C SW NE 27-6n-3w, Fremont County. The well flowed 256 bbl. of oil from the Phosphoria on a 4-hour flow through open 2-in. tubing, and 79 bbl. from the Curtis.

The daily flow would be 2,016 bbl. based on the 4-hour flow tests. Perforations in the Phosphoria are at 4,640-90 ft.; Curtis at 3,384-3,450 ft.

Location of the Wolff Lake discovery is 1½ miles northwest of Northwest Sheldon Dome field.

COLORADO

North Park Basin Gets New Pay Hike

Continental Oil Co. apparently has a new-pay discovery at its 1 Sherman B wildcat at North McCallum field in Jackson County, northern Colorado.

The operator recovered 115 bbl. of oil in 7 hours on test of Muddy perforations at 6,184-6,214 ft. Other production in this field is from the

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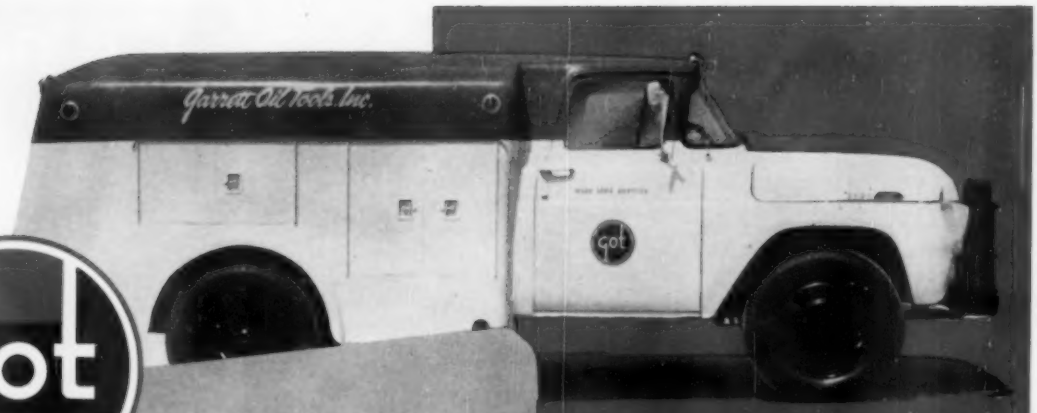

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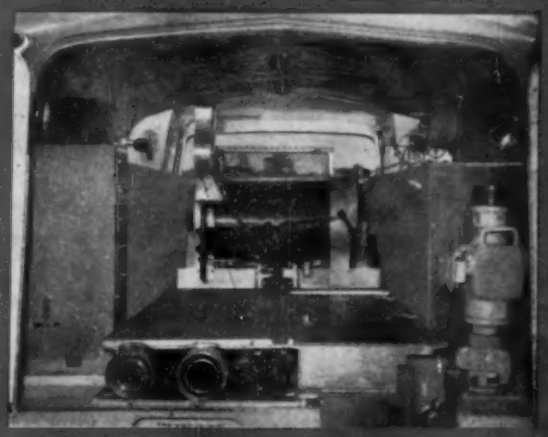

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Dakota and Morrison. Location of the discovery is on the southwest flank of the field.

UTAH

Important Hatch Unit Discovery Completed

The important northside Paradox basin at Hatch Unit was completed by Reynolds Mining Co. The well, 12 miles north of Aneth field itself, was completed flowing 733 bbl. of oil per day on 1-in. choke from Paradox-Pennsylvanian perforations at 5,967-87 ft.

The Hatch Unit discovery is the first strike north of the general Aneth area and is a key to the future drilling between Aneth and Hatch. There has been considerable wildcatting in this general San Juan County area but no success has been recorded until Hatch Unit. The Hatch well is the fourth on this block, the other three being dry. The Unit includes 70,000 acres.

Big Flow Reported at Ratherford Field Well

A well in Ratherford field, San Juan County, flowed at the rate of 2,088 bbl. of oil per day on 48/64-in. choke from perforations at 5,367-5,545 ft. The prolific producer is Shell Oil Co.'s 33-12 North Desert Creek in SW NW SE 12-41s-23e.

Three Wells Completed In South Aneth Area

Three wells were completed in the southern part of Aneth field last week in San Juan County. The Texas Co. finalled all three.

The 9 Navajo-D, NE SW NW 22-40s-24e, made 1,392 bbl. of oil per day on 1-in. choke from Aneth pay at 5,582-5,680 ft. The 6 Navajo-D, C SE NW 21-40s-24e, flowed 1,368 bbl. per day from Aneth pay at 5,350 ft. The 13 Navajo-C, E½ SE SW 24-40s-24e, flowed 870 bbl. per day on 1-in. choke from perforations at 5,642-5,762 ft.

Successful Wildcats

ALBERTA

Canadian Chieftain Tidal 7-7-24-10 Cessford, LSD 7, 7-24-10w4. TD 2,850 ft. Viking sand gas.

Canadian Montana Gas 10-17-29-5 Oyen, LSD 10, 17-26-5w4. TD 3,005 ft. Viking sand gas.

Phillips 2-19 Antelope, LSD 2, 19-32-28w3. TD 2,950 ft. Viking sand gas.

BRITISH COLUMBIA

Pacific Scurry 1 Dawson Creek, LSD 1, 15-79-15w6. TD 2,900 ft., Cadotte gas.

Texaco-N.F.A. 11 Buick Creek, 94-A14-A-31. Nikinassin gas discovery. TD 4,546 ft.

SASKATCHEWAN

Imperial 16-31-9-1 Cannington Manor. LSD 16, 31-9-1w2. Mission Canyon oil discovery. TD 3,850 ft.

CALIFORNIA

Kern County: The Texas Co. 2 Tejon Ranch B, SE NE 6-10n-19w, 156 BOPD, 21.3° gravity, 3 per cent cut, perfs. 5,370-5,423 ft., 16/64-in. choke, 7,527 TD. (New pool discovery southwest of the western area of production in the Tejon field.)

Ventura County: The Texas Co. 16 Elkins, SW NW 5-3n-19w, 239 BOPD, 28° gravity, 2.6 per cent cut, 21/64-in. choke, perfs. 6,396-6,400 ft., 6,406-13 ft., 6,420-45 ft., 6,627-6,825 ft., TD 7,548 ft. (Deeper Pliocene zone discovery in Shiells Caynon field.)

COLORADO

Rio Blanco County: The Texas Co. 1 Government-Cheney, C SE NE 25-3n-87w, IPP 3 BOPD, 25 BW, Dakota 3,754-90 ft. TD 4,397 ft. Oil discovery.

Weld County: Tri-State Exploration (A. C. Torgeson) 1 State, C SW SE 34-3n-62w. IPF 135 BOPD, "D" sand 6,758-64 ft. TD 6,867 ft. Oil discovery.

Morgan County: McKnab Drilling Co. 1 Jess, C SW NE 14-4n-58w. IP 3,810

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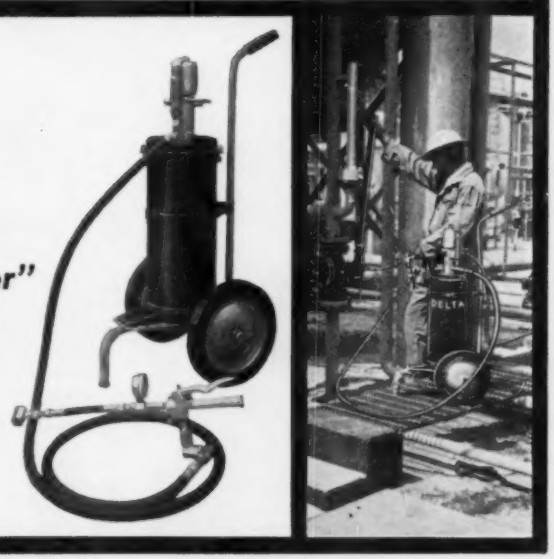

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M.c.f. of gas per day, "D" sand 5,783-93 ft. TD 5,927 ft. Gas discovery.

Moffat County: Malco Refineries 1 Komach, C NW NW 25-6n-90w. IPP 221 BOPD, Weber-Penn 10,070-80 ft. TD 10,200 ft. 45.3°. Oil discovery.

Logan County: Brack Drilling Co. 1 Scott, C SW NW 3-8n-48w. IP 3,700 M.c.f. of gas per day, "J" sand 4,112-20 ft. TD 4,424 ft. Gas discovery.

Weld County: Shell Oil Co. 1-1134 State, C NW SE 16-11n-58w. IPF 210 BOPD, "D" sand 6,942-43 ft., 6,945-48 ft., 6,949-51 ft. TD 7,121 ft. Opens Vim pool.

Central Oil Corp. 1 Government "G," NE NE 12-11n-57w. IPP 43 BOPD, 35 per cent water, "J" sand 6,591-96 ft. TD 6,710 ft. Oil discovery.

TEXAS GULF COAST

Bee County: John B. Hawley, Jr., 4 P. S. Dugat estate, James Gray Sur., A-170 (4 miles southwest of Pettus). IP 20,000 M.c.f. daily, absolute open-flow potential, GLR 96 M.c.f. per barrel, shut-in pressure 1,582 psi., perfs. 4,084-88 ft. (Yegua). TD 4,251 ft. (New pay in West Cosden field.)

Galveston County: Hassie Hunt Trust 1 Tacquard Unit, Lemuel Crawford Sur., A-47, Lot 310 (1 mile southwest of Alta Loma). IP 23,000 M.c.f. daily, absolute open-flow potential, GLR 3,850 cu. ft. per barrel, 52.1°, shut-in pressure 6,961 psi., perfs. 12,368-72 ft. (Frio). TD 13,600 ft. (New pay-north flank of Alta Loma field.)

Jackson County: Trunkline Gas Co. 1 Mauritz Brothers, B. J. White Sur., A-81, Lot 13 (6 miles south of Ganado between North LaWard and Maubro fields). IP 80,000 M.c.f. daily, absolute open-flow potential, GLR 91.6 M.c.f. per barrel, 54.8°, shut-in pressure 2,273 psi., perfs. 6,194-96 ft. (Frio). TD 7,859 ft. (New field.)

Newton County: Texas Gulf Producing Co. and Rowan Oil Co. 6 Morgan, George Hayden Sur., A-919 (3 miles west of Newton). IP 127.63 BOPD, 9/64-in., 41.5°, GOR 775 cu. ft. per barrel, TP 1,000 psi., perfs. 7,355-62 ft. (Frio). TD 7,901 ft. (New reservoir and extension—North Hartburg reservoir.)

Nueces County: Gilcrease Oil Co. 2-A Sanders, Sec. 165, BS&F Sur., A-55 (2½ miles southwest of Clarkwood). IP 135.19 BOPD, 7/32-in., 24.2°, GOR 93 cu. ft. per barrel, TP 115 psi., perfs. 4,276-79 ft. (Catahoula). TD 4,284 ft. (New pay in Baldwin field.)

Refugio County: William Carr 4 Hynes, Power & Hewitson Sur., A-54 (7 miles northeast of Refugio). IP 38,000 M.c.f. daily, absolute open-flow potential, shut-in tubing pressure 2,252-62 ft. (Oakville). TD 6,747 ft. (New pay in Lake Pasture field.)

WEST TEXAS

Crane County: The Texas Co. 7 T. C. Barnsley, 26-B27-PSL, gas discovery in N. Reed field. IP calculated open flow, 2,620 M.c.f. gas, Waddell perfs. 5,790-5,800 ft. Shut-in TP 1,971 psi. TD 6,210 ft.

Hockley County: K & H Operating Co. 1 Owen E. Williams, Sec. 64, Blk. A, R. M. Thompson Sur., 5 miles south Anton. IPP 120 BOPD, 32°-gravity, GOR 320, Strawn 9,952-62, 9,970-80 ft. TD 10,150 ft., elev. 3,406 ft.

Howard County: Nortex Oil & Gas Corp. 1 Shafer, 36-22-H&TC Sur., 1 mile west Pennsylvanian production in Vencent field. IPP 104 BOPD, 30°-gravity, GOR 300, Clear Fork 4,458-64 ft.; IP 1,228 BOPD, 28/64-in., 47°-gravity, GOR 800, CP 500 psi., Pennsylvanian reef 7,463-71 ft. TD 7,840 ft., elev. 2,373 ft. Dual completion.

Irion County: American Trading & Production Co. 1-44 A. A. Sugg, Jr., Sec. 44, Blk. 1, H&TC Sur., 5 miles north Mertzon. IPP 111.6 BOPD, 38°-gravity, GOR 150, Glorieta 1,948-58 ft. TD 3,255 ft., elev. 2,446 ft.

Midland County: El Paso Natural Gas Co. 1 Winkleman, Sec. 9, Blk. 28, T3S, T&P Sur., 15 miles east Midland, 4 miles south Azalea-Strawn field. IP 1,070 M.c.f. gas, plus 72 bbl. distillate, top Devonian pay 11,480 ft., TD 11,650 ft. Shut-in TP 2,431 psi.

Pecos County: Albert C. Bruce, Jr. 1 Shearer, 79-10-H&GN, 5½ miles south Imperial. IP 19 BOPD, ¼-in., 34°-gravity, GOR 600, TP 25 psi. Queen sand 1,864-74 ft. TD 1,880 ft.

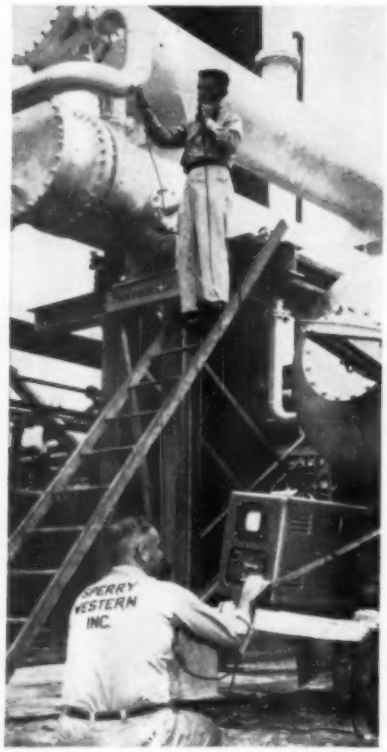
Standard Oil Co. of Texas 1 Helon Hokit "2," Sec. 7, Blk. 127, T&STL Sur., 15 miles southwest Bakersfield. IP 240 BOPD, 32/64-in., 47°-gravity, GOR 9400, TP 400 psi., Strawn 9,428-46 ft. TD 11,506 ft. Ground elev. 3,255 ft., Wolfcamp shale 6,590 ft., Canyon 8,773 ft., Strawn 9,429 ft., Ellenburger 11,166 ft.

WEST CENTRAL TEXAS

Fisher County: William D. Austin et al 1 Maberry, Bastrop CSL Sur. 323, Subd. 56, extension in Sylvester Goen area, 1 mile south Sylvester. IP 630 BOPD, 18/64-in., 52°-gravity, GOR 500, TP 600 psi., Strawn 5,340-50 ft. TD 5,416 ft.

Solved:

The Case of the "Inside Job"



Corrosion and erosion in high pressure plant and field processing systems are dangerous thieves, carrying on destructive "Inside Jobs" by unobtrusively and continuously stealing away the inner metal surfaces.

Unless checked periodically, excessive corrosion and/or erosion can progress undetected, creating the possibility of blowouts and consequent expensive and dangerous product and equipment loss.

This hazard can be avoided, however, by calling Sperry Western, Inc. (SWINC) to inspect high pressure systems regularly. Using the Ultrasonic thickness measurement method, installations—piping, tubing, separators, flow lines and pressure vessels — can be inspected quickly, efficiently and nondestructively. Normally, it is unnecessary to shut down operations for "SWINC" inspections.

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Ultrasonic thickness measurement of metal in a high pressure system is performed by skilled Sperry Western, Inc. inspectors to determine extent of metal loss resulting from inner corrosion and erosion.

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Reed Rock Bits

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During the early days of the unprecedented East Texas oil boom, Reed introduced the first rock bit having roller bearings supporting the replaceable rolling cutter assemblies. Today all popular-size bits with rolling cutters utilize roller bearings, but let's go back to those eventful days in East Texas.

In 1930 the quiet rural folk of East Texas wore long faces. A drouth had ruined their usual crops of cotton, sweet potatoes and corn, and their poultry and truck crops were being dumped on a pitiful depression market. They all fervently hoped for an oil field to solve their hardships.

It's little wonder that they watched with great expectancy as C. M. "Dad" Joiner's crew rigged up and spudded into Rush County's iron-colored soil near Overton. Enthusiasm was dampened by the abandonment of the first two wells. But on October 2, approximately 8,000 people assembled for the "drilling-in" of the No. 3 Daisy Bradford, which had shown earlier signs of oil. Cars and hacks backed up for miles along the roads—a carnival atmosphere prevailed with soda pop and peanut vendors hawking their wares. Finally on October 3, 1930, the well blew in throwing a spray of gas and oil over the crown block. This was it—a forest of yellow pine derricks appeared and Tyler, Kilgore, Longview, Gladewater, Henderson and Overton caught the oil fever in earnest. During the first fourteen years, the "Black Giant" produced more than twice the oil of any field in U. S. history.

And playing prominent roles in drilling the more than 25,000 East Texas oil wells were Reed roller bits. Just as the Reed 1930 model roller bearing rock bit set the pace for drilling performance *then*—Reed Y Bits, advanced 3-cone rock bits, are setting the drilling efficiency pace *today*.

BEST IN 1930 . . .

First Rock Bit with roller bearings supporting the rolling cutters in replaceable cutter assembly — 1930.

BEST TODAY . . .

REED Y BIT

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EAST TEXAS BLACK GIANT · 1930

Oil shoots over the crown block of the No. 3 Daisy Bradford, discovery well which touched off the epochal East Texas boom on October 3, 1930.

REED ROLLER BIT COMPANY

HOUSTON 1, TEXAS

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BP AND THE GEOPHYSICAL YEAR

ALL PETROLEUM PRODUCTS for the Commonwealth Trans-Antarctic Expedition have been supplied by The British Petroleum Company. In addition to large quantities of lubricating oil, 82,000 gallons of fuels of various kinds have been shipped in the "Theron", "Endeavour" and "Magga Dan". A member of BP's geophysical staff has been attached to the expedition to carry out scientific observations during the crossing of the Antarctic Continent.

The British Petroleum Company is proud of its association with the Expedition – a tribute to the high quality of all products marketed under the BP Shield throughout the world.

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Key Role in Socony Refining

. . . goes to Tom Simpson. Man who helped develop TCC process has hand in smooth operation of world-wide setup

MANAGING REFINING operations for a firm as widespread as Socony Mobil Oil Co. is somewhat like overseeing an empire. The company processes nearly 860,000 bbl. of oil daily on every continent except South America.

The new man in this king-size role is soft-spoken T. P. Simpson, former vice president and director of manufacturing for Socony's West Coast affiliate, General Petroleum Corp.

This fall Simpson took over the twin post of general manager of manufacturing and chairman of Socony's manufacturing committee.

Simpson moves up with a wealth of processing experience behind him. He's been in the Socony family 33 years and played a big part in one of the company's most notable achievements in refinery processing—the development of the Thermofor catalytic cracking process.

Fresh out of California Institute of Technology in 1924 as a chemical engineer, Simpson started with General Petroleum in development-type work at the process lab—before the company was actually doing formal research.

Socony-Vacuum Oil Co., Inc., tapped him in 1935 for the job of chief development engineer at the Paulsboro research and development laboratories in New Jersey.

To illustrate the progress in petroleum research in the past quarter of a century and Simpson's contribution to this growth, there were only 100 members on the Paulsboro lab staff at that time. Since then, the staff has increased nine-fold to 900 members.

TCC milestone . . . It was during his stint at Paulsboro that Simpson took part in the development of the Thermofor process. When catalytic cracking entered the picture in the late 1930's, Socony's research staff was focusing attention on ways to improve the fixed-bed process.

This effort was stepped up by the critical need for aviation gasoline during World War II. By 1943, the first commercial-size, moving-bed catalyst cracking unit went on stream.

Construction of TCC units was rushed during the war. Thirty-six of the elevator-type TCC reactors, with a combined capacity of almost 400,000 bbl. per day, were built.

The elevator later gave way to the airlift, and 49 additional airlift-type units are now in operation. About half of these are operating abroad.

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Simpson was made assistant director of research in 1944, and 3 years later he was promoted to director of Socony's research and development department. He held that position until he went back to General Petroleum in 1953 as assistant director of manufacturing.

In his new position with Socony, he succeeds R. Rea Jackson, who is the new chairman of the company's coordination committee.

He has written more than a score of scientific articles dealing with refining processes, and is a member of American Chemical Society, American Institute of Chemical Engineers, American Institute for Advancement of Science, and American Petroleum Institute. He and his wife, who have two sons, Gilbert and Thomas, Jr., live in New York.

Far-flung operations . . . As manager of manufacturing, Simpson has a hand in the smooth operations of Socony processing throughout the world. Socony and affiliates have 12 refineries in this country, scattered from coast to coast.

They also operate six European plants, one in Italy, England, Germany, and Austria, and two in France. Socony also has a stock interest in 10 other refineries in Iran, Saudi Arabia, Lebanon, Indonesia, Japan, India, Austria, and South Africa.

Last year the domestic refineries averaged runs to stills of 564,000 bbl. daily. Those in Europe averaged 144,000 bbl., and Socony's share in partly owned plants and under processing agreements elsewhere added up to 151,000 bbl. daily. This totals 859,000 bbl. daily.

Socony affiliates operate on a decentralized basis, but they have a lot of common interests, such as technical assistance and administrative manpower.

A big part of Simpson's new job is to see that these other interests are satisfied in the most satisfactory manner and with the least conflict.

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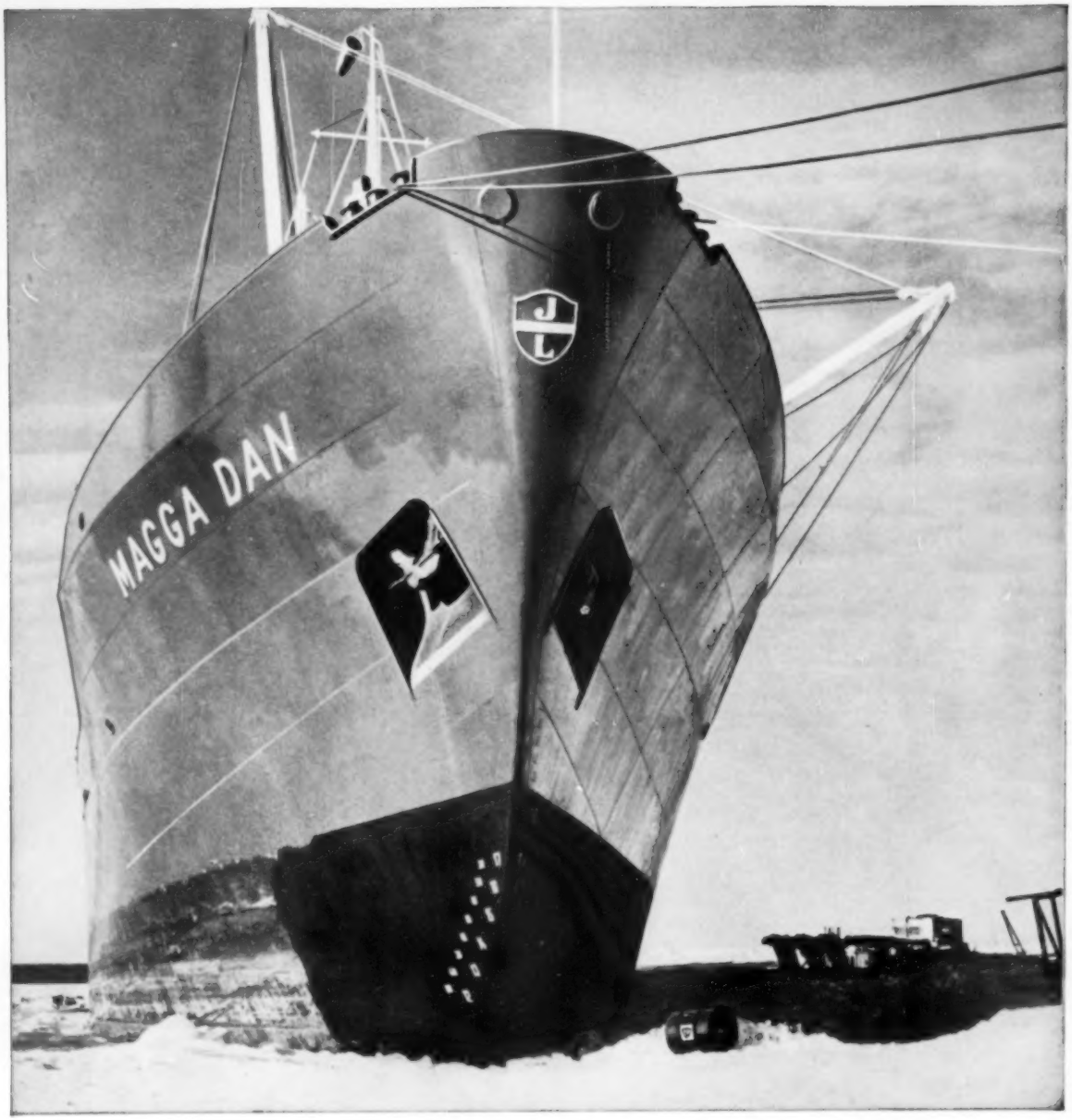
W. M. Warren, field superintendent for Pan American Petroleum Corp.'s Hugoton area office, Ulysses, Kans., has been transferred to West Edmond, Okla., as field superintendent for the northern and central Oklahoma area. **Ralph Ludwick,** field superintendent in Hays, Kans., replaces Warren as field superintendent in Ulysses. Warren had been field superintendent in Ulysses since 1941. Since 1950, Ludwick has served as field superintendent in Henderson, Tex., Monroe, La., and Hays.



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Association Elects New Slate

James S. Lauderdale, left, partner in Lauderdale & Straughan Drilling Co., Abilene, Tex., was elected president of the West Central Texas Oil and Gas Association at that group's recent annual meeting in Abilene. He succeeds E. Bruce Street, of Graham, Tex. Other new association officers, left to right from Lauderdale, are W. W. Wilson, Jr., Abilene, independent. James E. Russell, of James E. Russell Engineering, Abilene; William G. Arnot, Breckenridge independent; and Ray Dilger, Woodson Oil Co., Fort Worth. All are vice presidents.

V. A. Wade has been transferred by Union Oil Co. from Whittier, Calif., where he was petroleum engineer, to Santa Fe Springs, Calif., where he will be production foreman.

Alvan V. Brashear, assistant manager of operations for Michigan Consolidated Gas Co. since 1953, has been named manager of operations. Brashear joined the company in 1923. He succeeds the late Roland R. Paulin (see Deaths).

Richard J. Murdy, chief geologist for New York State Natural Gas Corp., has transferred to the parent company, Consolidated Natural Gas Co., as assistant to **E. H. Tollefson,** vice president.

James A. Kelley, Carter Oil Co.'s district production superintendent at Seminole, Okla., has been named assistant western division production manager in Denver. **John L. Dailey, Jr.,** assistant district superintendent at St. Elmo, Ill., has been transferred to Seminole to succeed Kelley as district superintendent there. At St. Elmo, **Joe H. Norman,** district engineer, moves up to succeed Dailey, and **Danny E. Shupp,** senior engineer, replaces Norman as district engineer. In other appointments, **Thomas R. Smith,** senior engineer at Carmi, Ill., has been transferred to Great Bend, Kans., as district engineer. He replaces **Weldon C. Butler,** who has resigned to join Arabian American Oil Co.

James L. Reeves has joined George Armistead & Co. in Washington as chemical engineer. He has been process engineer at Esso Standard Oil Co.'s Baltimore refinery since 1951.

R. L. Elkins, division mechanical engineer, and **J. W. Montgomery,** mechanical engineer, have been transferred by Shell Oil Co. from Hobbs, N. M., to Roswell, N. M. The move is a change in division production office location.

W. S. Godwin has been promoted by Texas Gas Transmission Corp. from manager of the firm's Clarksdale, Miss., compressor station to superintendent of the Tennessee-Mississippi division of its compressor department. The division takes in seven stations—two in Tennessee, five in Mississippi. Godwin succeeds **T. L. McWilliams,** who recently was named assistant superintendent of the company's gas compressor department. **T. C. Tatum,** manager of the Lula, Miss., compressor station, succeeds Godwin as manager of the Clarksdale station. **J. C. Stewart,** assistant manager of the Greenville, Miss., compressor station, has been transferred to Lula to replace Tatum. Also, Texas Gas has named **Aaron Griffin** assistant superintendent of dispatching at company headquarters at Owensboro, Ky. He formerly was assistant superintendent of the Kentucky-Indiana division of the pipeline department.

Personals

H. G. Schmidt, petroleum engineer, has been transferred to Casper, Wyo., from Venice, La., by The California Co.

Joseph D. Alcott, district foreman for Anderson-Prichard Oil Corp., has been transferred to Great Bend, Kans., from Farmington, N. M.

William H. Clingman, Jr., has been appointed group leader in the petroleum section of American Oil Co.'s research and development department. He joined the company in 1954.

A. R. Vander Ploeg, assistant director of research at The Texas Co.'s Port Arthur-Port Neches, Tex., laboratories, has been transferred to the research and technical department, Beacon, N. Y., as assistant to management.

E. D. Loughney and **D. L. Campbell,** vice presidents of British American Oil Co., Ltd., have been named senior vice presidents of the company. Loughney was appointed a vice president and director after Canadian Gulf Oil Co. was merged with British American last year. He is a director

E. D. LOUGHNEY

D. L. CAMPBELL

of several pipeline companies including Trans-Canada Pipe Lines, Ltd., Trans Mountain Oil Pipe Line Co., and Interprovincial Pipe Line Co. Campbell was BA manager of manufacturing before being elected a vice president in 1954. He was elected a director in 1956.

Rudolph Cubicciotti, vice president of L. Sonneborn Sons, Inc., has been elected president of National Lubricating Grease Institute. **F. E. Rosenstiehl,** The Texas Co., has been elected vice president; with **A. J. Daniel,** Battenfeld Grease & Oil Corp., re-elected treasurer. New directors of the group are **G. A. Olsen,** Sunland Refining Corp., **W. H. Saunders, Jr.,** International Lubricant Corp.; **B. G. Symon,** Shell Oil Corp.; **H. P. Ferguson,** Standard Oil Co. (Ohio); Rosenstiehl; and Daniel.

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SKELLY OIL COMPANY SKELLY

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Executive Headquarters: Tulsa, Oklahoma

Division Offices: St. Paul • Omaha • Cedar Rapids • Chicago • Tulsa • Wichita • Denver • Dallas

Personals

J. W. FERGUSON

J. W. Ferguson has been promoted by Continental Oil Co. from director of the economics and statistics division to director of natural gasoline and gas operations for the company. He will headquarter in Houston. Ferguson succeeds **C. L. Ritter,** who has transferred to New York with Constock Liquid Methane Corp., a Conoco affiliate. Ferguson joined Conoco in 1952 after 10 years as natural-gas engineer with the U. S. Bureau of Mines. He was with Colorado Interstate Gas Co. before that time.

William D. Conner, engineer with Preston Oil Co. in Newark, Ohio, has been promoted to production engineer and transferred to Columbus, Ohio.

C. C. (Larry) Liedholm has been named assistant general manager of Signal Oil & Gas Co.'s crude-production department. **R. C. Vlack** moves up to succeed Liedholm as manager of operations, production department.

W. M. Catterson, senior project engineer, construction, in the Montreal refinery of Shell Oil Co. of Canada, Ltd., has been appointed manager of the catalytic cracking department there. Catterson joined Shell in 1945.

D. N. Ezzell, district manager in Abqaiq, Saudi Arabia, for Arabian American Oil Co., has been appointed district manager in Ras Tanura, succeeding the late L. H. Rushmer. **Fred A. Abbott,** assistant district manager in Abqaiq, has moved up to district manager there. In other appointments, Aramco has named **J. D. Symons** assistant district manager in Abqaiq. He was formerly at Dhahran in the same capacity. **W. L. Crampton,** acting district manager at Ras Tanura, has been transferred to Dhahran as assistant district manager. Crampton will continue in his former post as assistant district manager in Ras Tanura until February 15. **H. C. Harper,** manager of manufacturing and oil supply in Aramco's New York office, has been named assistant district manager in Ras Tanura succeeding Crampton. **R. L. Savage,** coordinator of plants and pipelines in the company's general office in Dhahran, has been transferred to New York to succeed Harper.

D. F. Moore has resigned as vice president and manager of Osage Oil & Gas Co., Wichita, to become a consulting geologist.

Myrle M. Perkins, formerly with M. W. Kellogg Co., has joined Bechtel Corp. as executive engineer. He will be mainly concerned with business development in refining and petrochemicals.

Harry D. Dobe, formerly head of maintenance and construction planning and coordination for Esso Standard Oil Co. in Baltimore, has joined Great Northern Oil Co. as assistant maintenance superintendent.

John C. Dezelle, assistant division manager in Beaumont, Tex., for United Gas Corp., has been promoted to assistant operating manager of the company's Texas distribution operations. He will transfer to Houston December 1. Dezelle has been with United Gas since 1931.

SCHEINEMAN

Fred W. Scheineman, manager of the general engineering department for Standard Oil Co. (Ind.), has been appointed director of engineering. **Thomas A. Abbott,** manager of the engineering research department, has been named engineering administration manager. **Dr. Robert B. Jacobs,** technical director of the engineering research department, becomes engineering research manager, and **George M. Keranen,** assistant manager of the general engineering department, becomes manager of that department. The changes are part of a reorganization of Indiana Standard's engineering and engineering research departments. **George W. Watts,** who recently retired, was formerly director of both departments.

Donald B. Beecher, vice president and general manager of Equitable Gas Co., Pittsburgh, has been elected president. He succeeds **A. W. Conover,** who becomes chairman of the board. Conover steps down because of poor health. In other appointments, **John T. Brown** has been named executive vice president, a new position. **Fred N. Wolf** and **C. J. Mulholland** have been appointed senior vice presidents and directors. Beecher, the new president, has been with Equitable since 1926. He was elected vice president and general manager of the company in 1952.

JOSEPH SPIVAK

Joseph Spivak, chief geologist and assistant manager of exploration for Mobil Oil of Canada, Ltd., has been promoted to exploration manager and elected a director. **B. E. Taylor,** comptroller and a director of the company, has been named a vice president and treasurer. Spivak joined Mobil Oil in 1944. He was named chief geologist in 1951 and assistant manager of exploration in 1953. Taylor has been with the company since 1946. He has been comptroller since 1955, and was elected a director last year.

Hansford Lee Farris, Jr., has joined the headquarters staff of the Society of Exploration Geophysicists in Tulsa as editorial assistant.

G. J. McGraw, field foreman with The California Co., has been transferred to Casper, Wyo., from Wolf Point, Mont.

J. R. Stein, project manager of Dow Chemical Co.'s Louisiana plants now under construction near Baton Rouge, La., has been named general manager there. He will be responsible for construction and development work as well as production and other activities when the new plants go into operation next year. Stein has been with Dow since 1937.

DEATHS

Raymond William Gutzler, 62, Dallas independent oil operator, died November 6 in Dallas. Gutzler was active in Wichita Falls and Tyler during the North and East Texas oil booms.

E. C. Rechtin, 62, general manager of the Bethlehem Shipyards of Beaumont, Tex., and designer and builder of "Mr. Gus I" and "Mr. Gus II," died November 8 in Los Angeles.

Roland R. Paulin, 55, vice president and manager of operations for Michigan Consolidated Gas Co., died October 26 in Detroit. Paulin joined Michigan Consolidated in 1926 after graduation from Purdue University. He was elected a vice president of the company in 1950 and had been manager of operations since 1952

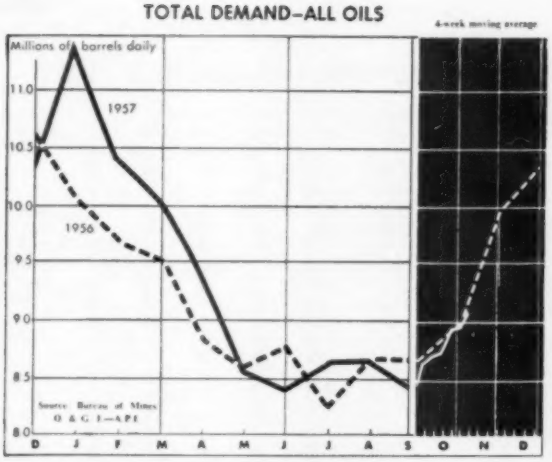
Martin Husmann, St. Louis independent operator, died November 3 in St. Louis.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,806,350	UP	86,150	DOWN	289,990
Crude stocks	283,111,000	UP	703,000	UP	280,000
Completions	1,066	UP	43	DOWN	30
Refinery runs	7,540,000	DOWN	40,000	DOWN	424,000
Gasoline stocks	180,805,000	DOWN	605,000	UP	8,962,000
Kerosine stocks	34,177,000	DOWN	87,000	DOWN	1,928,000
Distillate stocks	173,963,000	DOWN	1,166,000	UP	12,307,000
Residual stocks	59,338,000	DOWN	5,000	UP	11,910,000
Four-product stocks	448,283,000	DOWN	1,863,000	UP	31,251,000
Total imports	1,250,500	DOWN	335,900	UP	31,000

TOTAL DEMAND—ALL OILS



Product Demands Will Increase At Different Rates in Coming Years

THERE ARE several long-term trends in domestic demand for petroleum products which refiners are using as a basis for processing plans for the future.

The accompanying table shows these trends for four 5-year periods starting with 1936 and ending in 1955. The most outstanding shift is one most commonly known, the decreasing importance of residual fuels. The need for industrial fuels during World War II boosted sales of residual in the 1941-45 period. In this 5-year period residual fuel represented 29.0 per cent of the domestic demand, and the increases in residual demand accounted for 41.0 per cent of total gains for all oils.

Since the end of World War II, the picture has changed. Domestic demand for residual this year will be only about 10,000 bbl. daily higher than in 1950. Residual's position in the total picture dropped from 20.0 per cent of total demand for the 1941-45 period to about 17 per cent this year.

The growth in demand for gasoline has been an important factor in the over-all expansion in oil demand. Gasoline accounted for 44.8 per cent of total domestic demand in the 1936-40 period and 43.1 per cent in the 5 years 1951 through 1955. For the current year, gasoline demand will average between 43 and 44 per cent of the total for all products.

The outlook for gasoline over the next decade indicates continuing increases proportionate to the gains in total domestic demand. These are several factors which will influence gasoline's postion in the over-all demand picture.

Demand for aviation gasoline will decrease as reciprocating engines are replaced by jets. Some of the aviation-gasoline components will go into regular motor fuel. On the other hand, there should be a big jump in new drivers about 1963.

Also, the relative position of gasoline will be improved by the decline or at least the lack of growth in the use of residual and the slowing down of distillate sales.

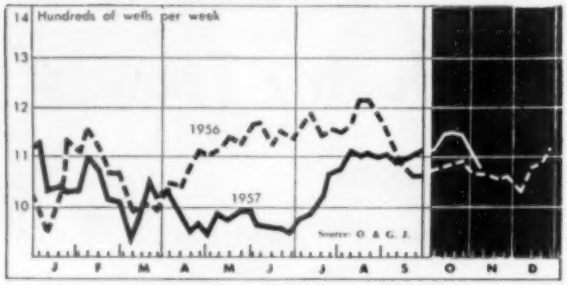
Distillate demand will continue to increase but not at past rates. Most of the railroads have already switched to diesels. Replacement of coal for home heating is about over. Gas has become a competitor. Coal will regain a part of the market through use of electricity to operate heat pumps.

Probably the greatest percentage gains will be in other products including LPG, asphalt, coke, jet fuels, and petrochemical base stocks.

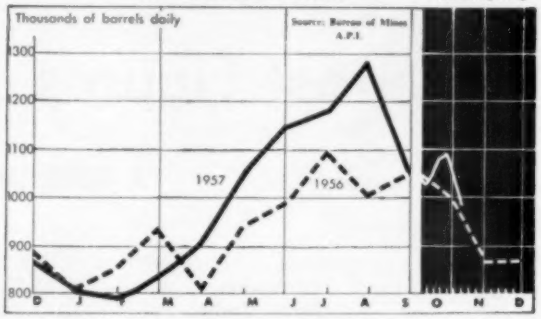
GROWTH IN DEMAND BY PRODUCTS
(Expressed as per cent of total domestic demand)

	1936-40	1941-45	1946-50	1951-55
GASOLINE				
Per cent of domestic demand	44.8	39.9	41.5	43.1
Per cent of demand increase	45.1	24.1	49.5	47.0
MIDDLE DISTILLATE				
Per cent of domestic demand	15.5	17.2	20.5	22.3
Per cent of demand increase	21.9	14.5	32.8	26.0
RESIDUAL FUEL				
Per cent of domestic demand	26.7	29.0	24.5	19.8
Per cent of demand increase	17.2	41.0	5.0	0.5
OTHER PRODUCTS				
Per cent of domestic demand	13.0	13.9	13.5	14.8
Per cent of demand increase	15.8	20.4	12.7	26.5

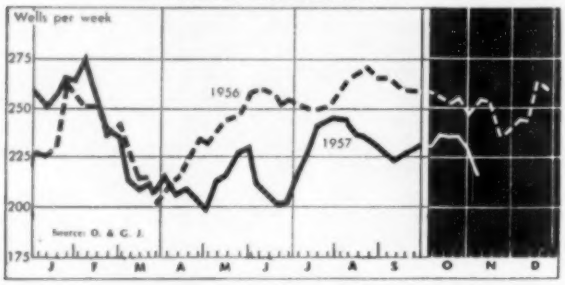
TOTAL COMPLETIONS



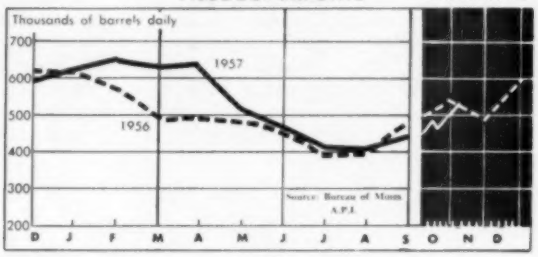
CRUDE IMPORTS



WILDCAT COMPLETIONS



PRODUCT IMPORTS

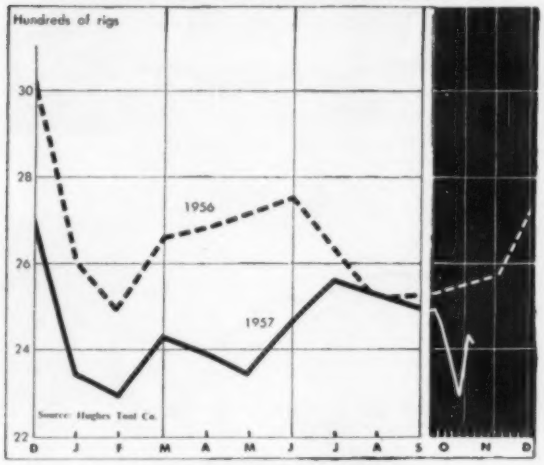


WEEKLY WELL COMPLETIONS . . . WEEK ENDED NOVEMBER 9, 1957

	Total wells							Cumulative		Total wildcats					Cumulative	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1957	1956	Total	Crude	Cond.	Gas	Dry	1957	1956
Alabama	0	0	0	0	0	0	0	69	‡98	0	0	0	0	0	23	‡44
Arkansas	24	12	0	1	11	0	72,950	960	816	3	0	0	0	3	175	164
California	49	38	0	0	9	2	183,469	1,902	1,902	8	2	0	0	6	451	442
Colorado	15	5	0	2	8	0	77,340	736	1,047	8	0	0	1	7	480	565
Illinois	46	15	0	0	31	0	110,054	2,314	3,403	10	1	0	0	9	545	665
Indiana	19	9	0	0	10	0	32,418	587	605	3	0	0	0	3	115	122
Kansas	68	31	0	3	34	0	248,544	3,620	4,297	13	3	0	0	10	715	938
Kentucky	36	4	0	9	23	0	59,289	1,300	1,637	8	0	0	0	8	262	376
Louisiana	78	35	8	3	32	0	578,550	3,334	3,265	15	1	4	1	9	590	658
North	32	21	0	1	10	0	93,676	1,232	1,441	6	1	0	0	5	167	228
South	44	14	8	1	21	0	464,458	1,512	1,477	8	0	4	0	4	346	366
Offshore	2	0	0	1	1	0	20,416	590	347	1	0	0	1	0	77	64
Michigan	6	2	0	0	4	0	14,723	385	380	3	0	0	0	3	135	145
Mississippi	6	0	0	0	6	0	49,835	335	381	3	0	0	0	3	169	187
Montana	20	11	0	0	9	0	80,369	370	401	4	0	0	0	4	142	151
Nebraska	23	10	0	0	13	0	139,437	776	822	11	1	0	0	10	423	409
New Mexico	39	28	0	6	5	0	176,058	1,851	1,660	2	0	0	0	2	238	237
Northwest	19	9	0	6	4	0	75,546	789	743	2	0	0	0	2	93	85
Southeast	20	19	0	0	1	0	100,512	1,062	917	0	0	0	0	0	145	152
New York	9	4	0	0	0	5	9,250	399	....	0	0	0	0	0	7	....
North Dakota	12	7	0	0	5	0	78,911	251	232	6	1	0	0	5	114	68
Ohio	32	15	0	4	11	2	66,825	981	934	0	0	0	0	0	16	12
Oklahoma	132	67	0	3	54	8	434,663	§5,473	7,142	20	3	0	1	16	§653	755
Pennsylvania	52	13	0	19	10	10	239,083	571	†959	0	0	0	0	0	41	†30
Texas	354	191	13	21	129	0	1,483,102	18,669	18,996	82	9	3	4	66	4,426	4,852
Dist. 1	26	6	0	5	15	0	93,128	1,075	*2,715	10	0	0	2	8	369	*949
Dist. 2	15	2	3	2	8	0	91,827	667	*2,267	4	0	0	1	3	232	*747
Dist. 3	23	13	2	1	7	0	139,291	1,448	....	6	1	1	1	3	405	....
Dist. 4	21	4	5	1	11	0	115,861	1,195	....	8	0	2	0	6	384	....
East	18	14	1	0	3	0	103,305	1,168	1,001	2	0	0	0	2	331	362
Dist. 7-B	76	43	0	2	31	0	185,513	2,553	....	15	1	0	0	14	864	....
West	109	76	1	1	31	0	513,990	5,291	5,095	20	4	0	0	16	752	803
Dist. 9	42	22	1	2	17	0	125,916	4,046	*6,774	12	3	0	0	9	991	*1,880
Dist. 10	24	11	0	7	6	0	114,271	1,226	1,144	5	0	0	0	5	98	111
Utah	8	4	0	0	4	0	43,423	208	120	4	0	0	0	4	105	75
West Virginia	16	4	0	10	2	0	37,568	603	596	1	0	0	1	0	30	20
Wyoming	18	10	0	2	6	0	43,784	740	767	3	1	0	1	1	250	237
Misc. (S. D., Tenn.)	4	0	0	1	3	0	11,607	120	71	3	0	0	0	3	102	64
Total U. S.	**1,066**	515	21	84	419	27	4,271,252	§46,554	50,531	**210**	22	7	9	172	§10,207	11,216
Total prev. week	1,023	501	9	70	421	22	3,995,571	.....	.....	187	10	2	5	170	.....	.....
Cum. 1957	§46,554	24,024	503	3,363	17,711	953	192,701,219	.....	.....	§10,207	1,020	94	347	8,746	.....	.....
Western Canada	46	24	0	6	14	2	201,981	2,616	2,772	14	0	0	4	14	740	.....

*Districts: 2 & 3, 1 & 4, 9 & 7-B, formerly combined. †Incl. New York. ‡Incl. Florida and Georgia. §Revised.

ROTARY RIGS OPERATING IN UNITED STATES



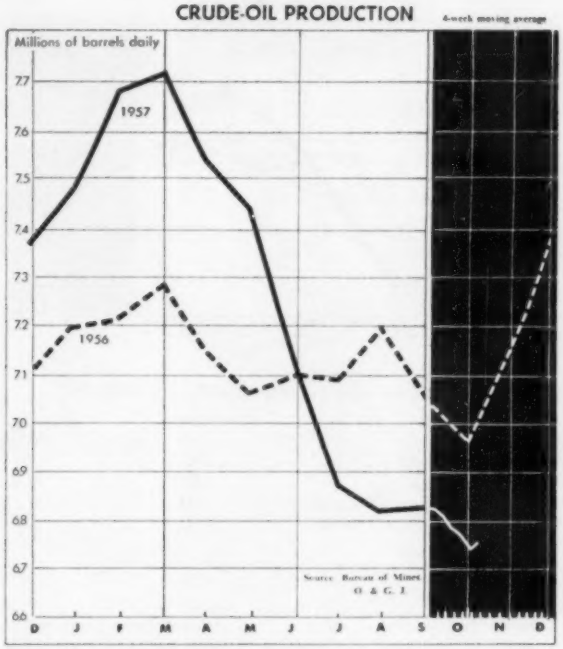
ACTIVE ROTARY RIGS*

Area—	11-11-57	11-4-57	10-28-57	11-12-56
Alabama	7	6	6	10
Arkansas	24	26	23	16
Arizona	1	1	1	....
California	84	82	84	111
Colorado	52	54	52	64
Florida	1	1	1	2
Georgia	....	....	....	....
Idaho	....	....	....	....
Illinois	65	60	50	62
Indiana	9	5	7	12
Iowa	2	2	2	1
Kansas	160	153	137	171
Kentucky	10	10	11	11
Louisiana	402	394	407	456
North	57	58	63	69
South	260	259	264	387
Offshore	85	77	80	(†)
Maryland	1	1	1	....
Michigan	11	13	13	16
Missouri	....	....	....	1
Mississippi	46	48	41	26
Montana	40	38	37	39
Nebraska	24	29	26	24
Nevada	....	....	....	2
New Mexico	153	138	136	128
New York	1	....	....	....
North Dakota	41	42	41	27
Ohio	1	1	1	....
Oklahoma	249	261	230	252
Oregon	....	....	1	....
Pennsylvania	12	13	13	7
South Dakota	2	2	1	....
Texas	874	909	839	1,018
Gulf Coast	179	163	159	250
Offshore	4	6	7	(‡)
West	358	369	338	385
North	287	321	294	322
East	46	50	41	61
Tennessee	....	....	....	....
Utah	54	57	54	29
Washington	1	1	1	1
West Virginia	4	3	3	3
Wyoming	80	82	78	69
Virginia	....	....	....	....
Total United States	2,411	2,432	2,297	2,558
Western Canada	166	163	179	252
Eastern Canada	2	2	3	....
Grand total	2,579	2,597	2,479	2,810

*Hughes Tool Co. †Included with South Louisiana. ‡Included with Texas Gulf Coast.

CRUDE-OIL PRODUCTION

4-week moving average

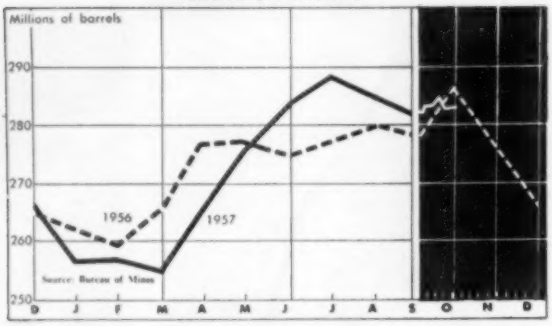


DAILY AVERAGE PRODUCTION FOR WEEK

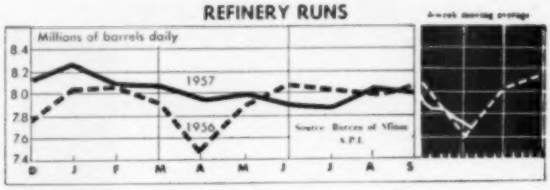
	November 9, 1957			Nov. 2
	Crude oil	Lease condensate	Total	total
Alabama	17,100	....	17,100	17,050
Arkansas	79,775	175	79,950	80,000
California	936,200	....	936,200	935,600
Colorado	143,700	....	143,700	146,400
Eastern	52,800	....	52,800	52,600
Florida	1,250	....	1,250	1,250
Illinois	224,600	....	224,600	226,900
Indiana	34,000	....	34,000	34,900
Kansas	†341,200	....	†341,200	†323,500
Kentucky	45,100	....	45,100	45,800
Louisiana	734,700	82,500	817,200	803,075
North	110,700	2,500	113,200	113,075
South	624,000	80,000	704,000	690,000
Michigan	27,900	....	27,900	27,600
Mississippi	93,700	4,400	98,100	104,300
Montana	77,450	....	77,450	77,900
Nebraska	56,550	....	56,550	55,050
Nevada	150	....	150	150
New Mexico	248,800	5,500	254,300	253,300
North Dakota	26,750	....	26,750	27,700
Oklahoma	†541,000	....	†541,000	†551,000
Texas	2,665,000	56,400	2,721,400	2,650,100
Dist. 1	50,000	525	50,525	48,500
Dist. 2	120,000	9,050	129,050	124,800
Dist. 3	380,000	27,000	407,000	400,800
Dist. 4	198,000	6,350	204,350	203,300
Dist. 5	32,000	450	32,450	32,300
Dist. 6	110,000	6,400	116,400	113,900
East Texas Field	162,000	....	162,000	155,000
Dist. 7-B	143,000	100	143,100	143,075
Dist. 7-C	150,000	3,850	153,850	141,875
Dist. 8	1,010,000	1,500	1,011,500	983,400
Dist. 9	207,000	600	207,600	200,600
Dist. 10	103,000	575	103,575	102,550
Utah	12,700	....	12,700	14,125
Wyoming	296,750	....	296,750	291,700
Others	‡200	....	‡200	‡200
Total U. S.	6,657,375	148,975	**6,806,350**	6,720,200
Change from prev. week, up			**86,150**	
Canada	†382,500	....	†382,500	†432,650
Total U. S. production—Jan. 1-Nov. 9				§2,255,082,600 bbl.
Same period last year (crude plus cond.)				*2,238,077,900 bbl.

*Includes 38,582,130 bbl. condensate. †Week ended previous Monday. ‡South Dakota. §Revised.

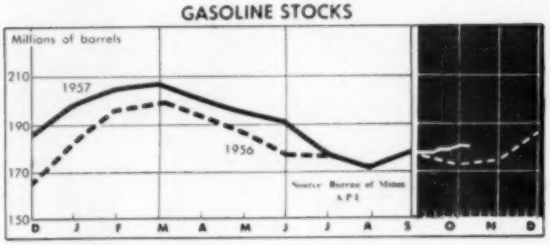
CRUDE-OIL STOCKS



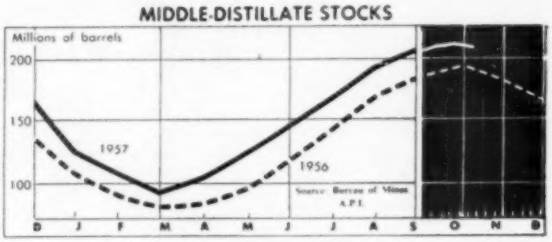
REFINERY RUNS



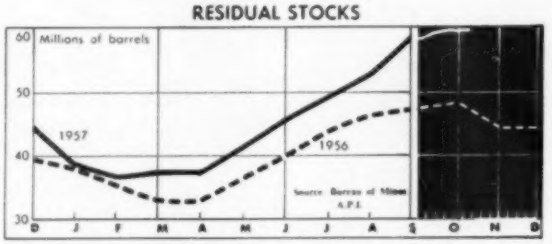
GASOLINE STOCKS



MIDDLE-DISTILLATE STOCKS



RESIDUAL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	11-2-57	10-26-57	11-3-56
Pennsylvania Grade	3,098	3,155	2,451
Other Appalachian	1,747	1,771	2,426
Illinois, Indiana, and Michigan	11,344	10,983	11,786
Nebraska and North Dakota	2,808	2,900	2,157
Kansas	10,379	10,264	10,491
Oklahoma	20,467	20,933	24,594
Arkansas	2,754	2,748	3,092
Louisiana	20,092	19,421	18,300
North	3,094	3,222	2,758
South	16,998	16,199	15,542
Mississippi, Alabama, and Florida	2,766	2,757	3,127
New Mexico	9,441	9,905	9,218
Texas	126,208	125,702	126,522
East Texas	9,883	9,638	8,698
West Texas	56,721	58,522	61,161
Texas Gulf	24,807	24,245	24,413
Other Texas	34,797	33,297	32,250
Wyoming	13,873	14,531	17,468
Other Rocky Mountain	7,025	6,394	6,235
California	32,010	32,382	29,413
Foreign	†19,099	18,562	15,551
Total	283,111	282,408	282,831

*Bureau of Mines. †Includes 5,891,000 bbl. in California.

API REFINERY REPORT, NOVEMBER 8, 1957

(Thousands of barrels)

										Bureau of Mines, November 1956				
	Daily	Daily average production				Stocks‡				Daily	Daily average production			
District—	avg. runs	Gaso.*	Kero.	Dist.	Resid.	Gaso.†	Kero.	Dist.	Resid.	avg. runs	Gaso.*	Kero.	Dist.	Resid.
East Coast	1,083	455.8	28.3	283.7	145.6	44,375	14,168	67,552	13,866	1,141	446.6	36.0	310.5	205.0
Appalachian:														
District 1	106	41.6	4.0	21.1	9.6	4,868	574	3,722	608	105	40.9	6.3	27.0	6.3
District 2	107	46.8	9.9	15.9	12.3	2,508	590	1,481	168	101	55.5	6.1	18.7	13.0
Ind., Ill., Ky.	1,341	741.8	61.0	272.2	168.4	30,452	7,168	24,996	6,082	1,429	742.3	78.0	295.3	193.1
Minn., Wis., Dak.	82	37.6	1.3	22.7	13.6	6,413	1,624	8,356	460	100	49.9	8.1	25.5	9.0
Okla., Kans., Mo.	636	340.0	13.0	131.9	22.7	14,103	1,856	13,727	1,139	694	379.0	17.1	176.1	33.8
Inland Texas	237	201.3	5.4	41.0	23.7	6,780	541	2,810	2,098	267	186.1	8.3	54.6	19.5
Texas Gulf Coast	1,724	869.0	97.4	457.9	199.2	23,681	3,501	19,751	7,382	1,960	896.7	135.8	490.8	252.1
La. Gulf Coast	641	344.3	38.8	173.7	49.0	11,519	2,766	8,964	1,491	667	368.9	68.5	165.9	56.1
N. La. and Ark.	94	32.7	6.3	22.1	5.4	4,420	676	2,294	202	103	42.2	9.9	22.2	6.9
Rocky Mountain:														
New Mexico	27	14.9	0.1	5.7	3.4	429	11	134	69	27	13.4	0.6	5.2	3.5
Other Rocky Mtn.	281	128.8	5.9	65.7	30.1	5,350	360	2,979	947	268	136.5	4.4	62.4	37.2
West Coast	1,181	491.6	4.9	182.1	338.6	25,907	342	17,197	24,826	1,170	501.3	4.5	187.3	346.8
Nov. 8, 1957	7,540	3,746.2	276.3	1,695.7	1,021.6	180,805	34,177	173,963	59,338	8,032	3,859.3	383.6	1,841.5	1,182.3
Nov. 1, 1957	7,580	3,860.6	271.7	1,725.3	1,050.6	181,410	34,264§	175,129	59,343	.....	.....	.....	.....	.....
Nov. 9, 1956	7,964	3,816.3	386.3	1,755.6	1,182.1	171,843	36,105	161,656	47,428	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines. §Revised.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (89 octane)	11.50-11.75
Premium (98 octane)	14.25-14.50
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.75-11.00
Regular (92 octane)	11.00-11.25
Premium (97 octane)	12.50-12.75
Premium (98 octane)	12.75-13.00
California (rack) (Los Angeles):	
Regular (88 octane)	12.2
Premium (96 octane)	14.8
Premium (98 octane)	15.0
Caribbean area (cargoes):	
Regular (87 octane)	10.625
Premium (93 octane)	11.50

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
Grade 26-70	4.5
Breckenridge:	
Grade 26-70	4.0

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16 lb. Prices for grades below 16 lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	9.50-10.00
Diesel oil (58 d.i. and above)	9.125-9.75
Distillate No. 1	9.125-9.75
Distillate No. 2	8.50-9.00
Gulf Coast (cargoes):	
Kerosine 41-43	8.75-9.50
Distillate No. 2	8.75-9.50
New York Harbor (barges):	
Kerosine 41-43	10.75
Distillate No. 2	10.25
Diesel fuel, 48-52 d.i.	10.55
Caribbean area (cargoes):	
Distillate No. 2	9.00

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude-scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$1.60-1.80
Gulf Coast (cargoes):	
Bunker C fuel	$2.50-2.75
New York Harbor (barges):	
Bunker C fuel	$2.95
Caribbean (cargoes):	
Bunker C	$2.55
California (rack):	
Bunker C fuel, Los Angeles	$2.85-3.00

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i.	25.5
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	22.25
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	28
200 vis. neutral (180 at 100°), 25 p.t.	26

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour) (§)
14-14.9	$2.67	....	....	....	....
15-15.9	2.71	....	....	....	$1.81
16-16.9	2.74	....	....	....	1.86
17-17.9	2.78	....	....	....	1.91
18-18.9	2.82	....	....	....	1.96
19-19.9	2.85	....	....	....	2.01
20-20.9	2.89	$2.75	....	$2.62	2.06
21-21.9	2.93	2.77	....	2.64	2.11
22-22.9	2.97	2.79	....	2.66	2.16
23-23.9	3.01	2.81	$3.44	2.68	2.21
24-24.9	3.05	2.83	3.46	2.70	2.26
25-25.9	3.09	2.85	3.48	2.72	2.31
26-26.9	3.13	2.87	3.50	2.74	2.36
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95	....	2.82	2.63
31-31.9	3.38	2.97	....	2.84	2.67
32-32.9	3.44	2.99	....	2.86	2.71
33-33.9	3.50	3.01	....	2.88	2.75
34-34.9	3.56	3.03	....	2.90	2.79
35-35.9	3.61	3.05	....	2.92	2.83
36-36.9	3.65	3.07	....	2.94	2.87
37-37.9	3.68	3.09	....	2.96	2.89
38-38.9	....	3.11	....	2.98	2.91
39-39.9	....	3.13	....	3.00	2.93
40 and up	....	3.15	....	3.02	2.95

*Includes Oklahoma, part of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low cold test Gulf Coast. ‡Sour. §Most buyers are posting Wyoming sour in two schedules, 15°-26.9° and 27°-40°.

Effective dates: California January 17, 1957, east of California, January 3-January 10, 1957; Pennsylvania Grade, July 26, 1957.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.65
Middle District	4.47
Southwest Pennsylvania	4.18
West Virginia	4.00
Buckeye Grade	4.00
Zanesville Grade	3.04
Illinois Basin	3.15
Canada:	
Leduc-Woodbend	2.74
Redwater (Alta.)	2.63
Smiley (Sask.)	2.40
Pembina	2.61

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 41°-41.9°, Puerto La Cruz	3.34
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
Quiriquire, 16.5°-16.9°, Caripito	2.45
Lagunillas heavy, flat, Amuay or Las Piedras*	2.38
Bachaquero, flat, Las Piedras*	2.23

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$2.12
Iranian, 34.0°-34.9°, Bandar Masur	2.04
Iranian, 34.0°-34.9°, Abadan	1.99
Iraq, 36.0°-36.9°, Fao	2.00
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.85
Qatar, 41.0°-41.9°, Umm Said	2.23
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.59
Iraq, 36.0°-36.9°, Tripoli, Banias	2.59
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.75

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★ Carib.-U.S.N.H., dirty (USMC—65%)	0.95
★ P.G.-Gulf, dirty (USMC—62.5%)	5.46

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Engineering Fundamentals on Petroleum Reservoirs	2.00
Fundamentals of Electric Logging	1.50
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Instrumentation	1.00
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Process Techniques for H_2S Extraction-Sulfur Manufacture	1.00
Pumps, Fans and Blowers	1.00
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500,000 feet No. 1—12¾" O.D. ⅜" Wall 49.56 lbs. straightened machined cleaned, beveled ends, 20 and 40 ft. lengths.

MARINE SALVAGE & EQUIPMENT CO.,
Phone RAymond 2623
P. O. Box 1471, New Orleans, La.

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WANTED—One Used Pipe Machine, ½" to 2" or ½" to 4". Firman Equipt. Corp., Terre Haute, Indiana.

WILL PAY CASH for good 4 to 5 thousand foot rotary rig. No junkers. Desire 8 ft. or higher substructure, 96 ft. derrick or higher, 12 or 14 inch pump, 4½" drill pipe, 17½" to 21" rotary table. Prefer diesel power. Enclose complete inventory and location of rig in first letter, and bottom dollar you will accept. Box K-436, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

MECHANICAL ENGINEER and/or Draftsman for design and development of oil field production equipment and ASME Code pressure vessel design. Experience required. Submit photograph, statistics, resume of experience, and salary required to Box K-414, The Oil and Gas Journal, Tulsa, Oklahoma.

Mechanical Engineer
Bachelor's Degree or Better

Excellent opportunity investigating Domestic Burner Equipment and Fuels. Studies concerned primarily with Mechanical Factors Influencing Burner operation.

SOCONY MOBIL OIL COMPANY, INC.,
Technical Service Laboratory,
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Long established small but active independent, operating principally in Mid-Continent area, has opening with attractive future for qualified individual with approximately 8 years geological and/or petroleum engineering background and some administrative ability. Salary commensurate with ability and experience. Send full particulars to

Box K-412,
The Oil and Gas Journal,
Tulsa, Oklahoma.

HELP WANTED

FOREIGN EMPLOYMENT. List oil companies, drilling contractors, seismograph contractors, showing where apply foreign jobs. $5.00 cash. OIML Co., Box 2603, Tulsa, Okla

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Due to expanding laboratory, a large midwest refinery has several interesting positions awaiting outstanding graduate chemists. Work with new waste water treatment plant or alkylation unit. We prefer one year's experience in chemical plant, petro-chemical, or oil refinery. Good starting salary, achievement observed and rewarded; liberal employee benefits. Replies held confidential.

Box K-434,
The Oil and Gas Journal,
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The Oil and Gas Journal,
Tulsa, Oklahoma.

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. . . with at least five years experience in marketing, including some experience or knowledge of refinery sales.

A PERMANENT POSITION
with a natural gas processing company. Please submit resume of experience and indicate salary desired.

Write: Box K-372,
The Oil and Gas Journal,
Tulsa, Oklahoma.

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required by
CANADIAN INDEPENDENT

To operate Gas Plant with minimum of 25 million cu. ft./day. Applicants should have 10 years' experience in operation of absorption-refrigeration type plant producing L.P.G. and residue gas.

Salary commensurate with training and experience. Liberal employee benefits.

Write, giving resume, to:

DOME EXPLORATION (WESTERN) LIMITED
528—9th Avenue S. W.
CALGARY, ALBERTA, CANADA
All replies held in strictest confidence.

HELP WANTED

DRILLING ENGINEER or Tool Pusher with long, thorough experience in all techniques of drilling, testing, and well completion, wanted by oil company operating in North Africa. Furnish full information on education, experience, salary. Box K-410, The Oil and Gas Journal, Tulsa, Oklahoma.

CORE ANALYSIS SUPERVISOR with reservoir performance experience. Must be capable of supervising company laboratory operated by large independent in Illinois. Ability to devise non routine test procedures to evaluate various reservoir problems is required. Furnish photo, full information regarding education, experience and personal history. All inquiries will be kept in strictest confidence. Box K-421, The Oil and Gas Journal, Tulsa, Oklahoma.

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616 S. Main • Tulsa, Oklahoma • LU 4-3601

HELP WANTED

GRADUATE ENGINEER with engineering and safety experience, preferably in refinery. Mid-Continent area with expanding company. Send photograph and complete personal history, including education, experience and salary requirement. Box K-409, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST with minimum of 5 years Gulf Coast experience who desires to begin work with independent operators and share expense and profits. Locate in Houston. No salary. Overriding royalties on all prospects. Send brief outline of experience. All replies held in strict confidence. Box K-433, The Oil and Gas Journal, Tulsa, Oklahoma.

SUB-SURFACE Exploration Geologist. Large independent oil company has opening for steady, responsible geologist with 5-7 years Gulf Coast experience. Prefer married man under 35. Send resume of background and experience, and small photo to Box K-429, The Oil and Gas Journal, Tulsa, Oklahoma.

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THE POSITION YOU WANT: Oil Industry companies are looking for men to fill every conceivable kind of position. If you didn't find the position in this column that you are looking for, use a "Situation Wanted" classified advertisement to state your qualifications. Some company is probably looking for your ability. See box heading for classified rates or write The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

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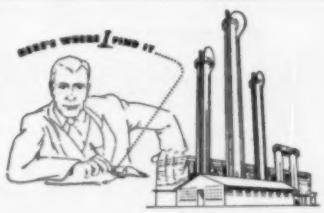
FOREIGN EMPLOYMENT

desired by petroleum geologist with four years Canadian and two years South American experience, excellent references. Age 30.

BOX K-435,
THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA.



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TULSA, OKLAHOMA.

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	Bids to be Opened:
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Block 3:	
Tracts 110 through 128, Utah, and Tracts 129 Through 160, Arizona	2-11-58
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Tracts 161 through 174, Utah, and Tracts 175 through 197, Arizona	3-19-58

Details of the lease offering and filing of bids may be obtained by addressing an inquiry to the General Superintendent, Navajo Indian Agency, Attention: Branch of Realty, Window Rock, Arizona.

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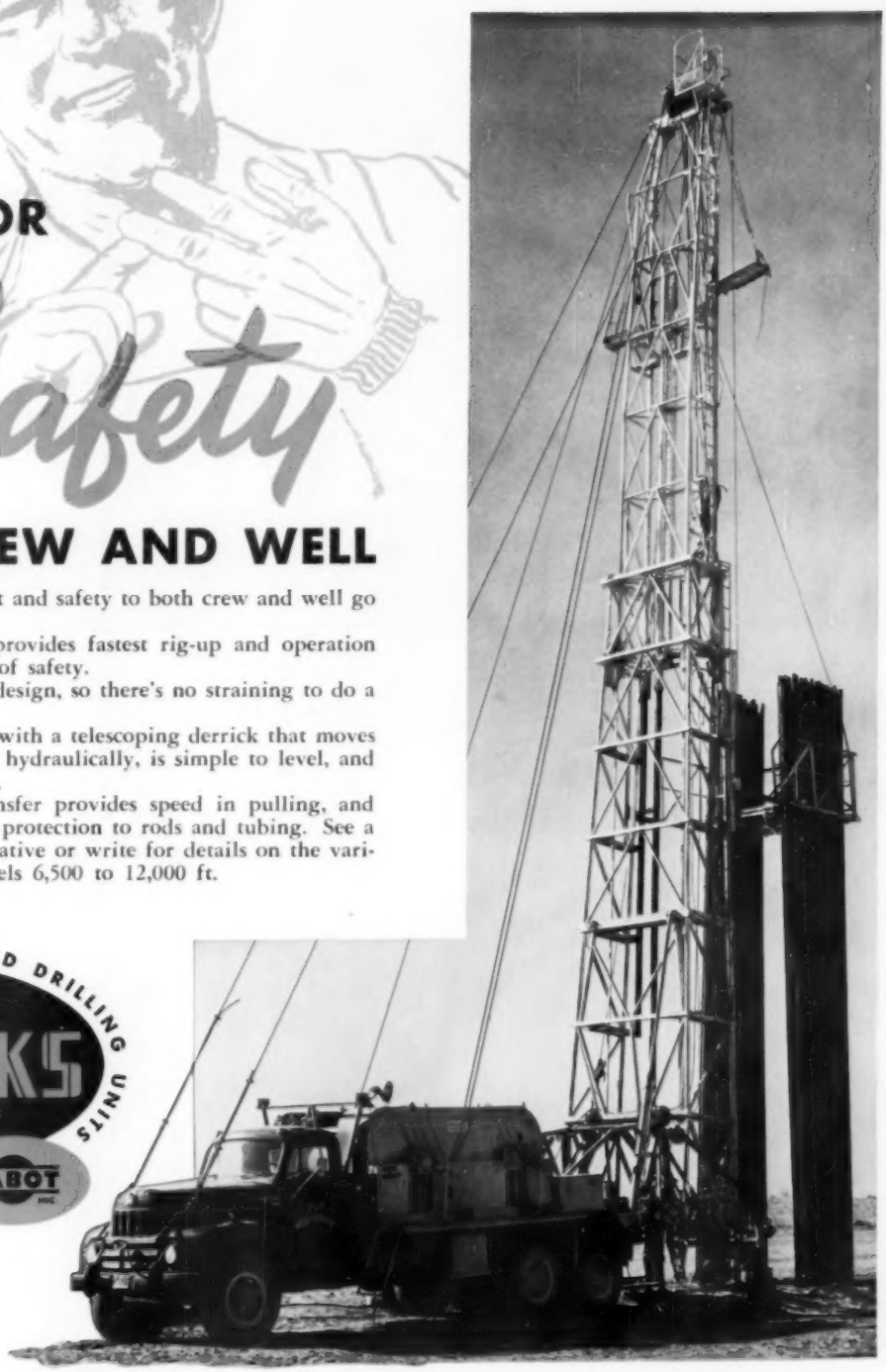

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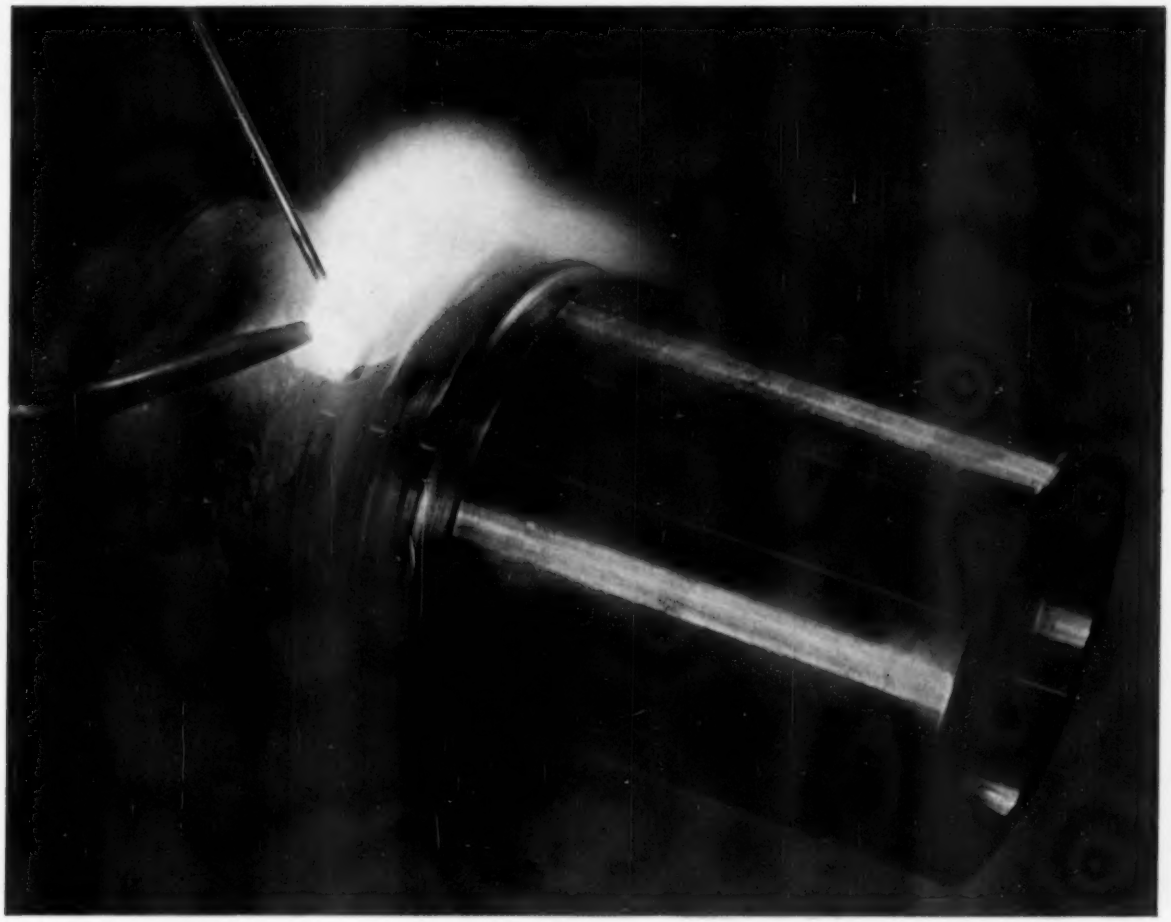

Why spend 150% more for your tool joints?

Records show that Hughes hardfaced tool joints give you service equal to two and often three sets of non-hardfaced joints . . . at a fraction of the cost!

For that reason most contractors and operators who expect to use their drilling strings in abrasive formations buy hardfaced joints.

Hughes tool joints are hardfaced with a Hughes-developed carbide hardfacing—*"Hughesite"*—more than 25 times as wear-resistant as hardened steel. Application is by a special Hughes-developed process that assures uniform distribution of carbide particles for maximum resistance to wear.

You get the best possible protection for tool joints when you get Hughes hardfacing . . . proved in 15 years of field service and on millions of feet of drill stem.

HARDFACING is available on "Seal-Grip" and on tapered and square shoulder "Flash-Weld" tool joints.

HUGHES TOOL COMPANY · HOUSTON, TEXAS

DEVELOPERS OF "FLASH-WELD," "SEAL-GRIP" AND COUNTERBORE WELD TOOL JOINTS